



Maryland Department of Agriculture
Specialty Crop Block Grant
Agreement Number: 12-25-B-1675
Final Report

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FINAL REPORT

Project Title: Maryland's Best: Promoting Maryland's Specialty Crops

PROJECT SUMMARY

Maryland's Best specialty crop promotions encouraged consumers from Maryland and Washington DC to seek out and purchase Maryland grown specialty crops through strategic promotions and advertising with radio, TV, print and online media. The specific specialty crops promoted using this grant include nursery and greenhouse plants and flowers, strawberries, wine, the Buy Local Challenge, watermelons, peaches, apples, pumpkins, and Christmas trees.

This project was completed in a timely manner and followed the timeline according to the original proposal. It is important to execute all promotions in a timely manner, in order to best support seasonal specialty crops in the market.

The specialty crop block grant has supported Maryland's Best specialty crop promotional efforts in previous years and has helped to increase sales and demand for these products. Evidence of its continued success is apparent in this report.

This project has been previously funded and continues to increase demand and sales for Maryland grown specialty crops. A majority of the specialty crop promotions funded through this grant drive consumer traffic to the Maryland's Best web site which helps source specialty crops. We have seen a steady increase in visits to the web site and in sales of specialty crops, largely in part to the promotional efforts funded by this grant.

There are a few specialty crop organizations in the state and a majority of the organizations have volunteer boards with no staff to plan and implement much needed Maryland grown promotions. These promotions increase consumer demand for Maryland grown specialty crops in the MD and DC region, which is a very competitive market due to large amounts of produce sold there from outside the US and region.

PROJECT APPROACH

All of the Maryland's Best specialty crop advertising paid for by this grant directs consumers back to the Maryland's Best web site. Once at the Maryland's Best web site, seasonal specialty crops are featured on the home page and consumers are directed to the search feature to find specialty crop producers near them.

GOALS AND OUTCOMES ACHIEVED

2014 Specialty Crop Advertising Plan

Month	Target Promotion	Target media	Web Visits
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April	Nursery and Garden Centers	WYPR	3,105
(***) is made possible by the Maryland Department of Agriculture's Maryland's Best Program, inviting listeners to enjoy the outdoors and spend time in your garden. To learn about planting trees, shrubs, bulbs and flowers to enjoy this spring and summer, and to find a local nursery or garden center near you, marylands best dot net			
May	Strawberries	WYPR	5,587
(***) is made possible by the Maryland Department of Agriculture's Maryland's Best Program, inviting listeners to enjoy fresh, local strawberries. Selecting berries includes looking for a full, bright-red color and firm, plump flesh. To find farm stands, pick your own, and farmers' markets featuring Maryland strawberries, Marylands best dot net.			
June	Wine	WYPR,	5,034
(***) is made possible by the Maryland Department of Agriculture's Maryland's Best Program, celebrating Maryland Wine Week, June 13th through the 23rd. Restaurants and wine shops around Maryland will host events themed around Maryland wine, including wine maker dinners, tastings, wine flights, and more. For more information, Marylands best dot net			
July	Buy Local Challenge	WYPR, , Washington Post	6,045
(***) is made possible by the Maryland Department of Agriculture's Maryland's Best Program, inviting listeners to eat locally grown produce during Maryland's Buy Local Challenge, now through July 27th. Available at farmer's markets, farm stands and the "local section" of grocery stores. For information, marylands best dot net			
August	Watermelons, Peaches,	Press Release	4,063
September	Watermelons/Apples	Washington Post, WYPR, WBAL	4,834
(***) is made possible by the Maryland Department of Agriculture's Maryland's Best Program, inviting listeners to enjoy fresh, Maryland apples. Available at your local grocery store or ask the produce manager. To find farm stands, pick your own, and farmers' markets featuring Maryland apples, Marylands best dot net			
October	Apples, Pumpkins	Washington Post, WYPR, WBAL	5,798
(***) is made possible by the Maryland Department of Agriculture's Maryland's Best Program, inviting listeners to enjoy fresh, Maryland apples. Available at your local grocery store or ask the produce manager. To find farm stands, pick your own, and farmers' markets featuring Maryland apples, Marylands best dot net			
December	Christmas Trees	Washington Post, WYPR, WBAL	4,031
(***) is made possible by the Maryland Department of Agriculture's Maryland's Best Program, inviting listeners to visit a Maryland Christmas tree farm. This holiday season, local farms have trees, wreaths, garlands, and more. To find a farm near you, Maryland's best dot net			

Advertising Impressions and Listeners

Month	Promotion	Estimated Print Ad Impressions	Estimated Radio Ad Listeners
April	Nursery and Garden Centers	No print ads	400,000

May	Strawberries	No print ads	400,000
June	Wine	No print ads	400,000
July	Buy Local Challenge	455,289	400,000
September	Watermelons/Apples	1,524,023	400,000
October	Apples/Pumpkins	1,762,059	400,000
December	Christmas Trees	1,230,986	600,000
Total Reach		4,972,357	3,000,000

Buyer-Grower Event

In January, MDA hosted a Buyer-Grower Event at the Navy-Marine Memorial Stadium – N Room. This tradeshow style event is designed to connect Maryland specialty crop growers with buyers from grocery retailers, restaurants, schools, and other venues. In 2014, we had nearly 400 registered buyers, producers, and industry professionals. This is up from 300 registered in 2013.

Maryland's Best Soundbooks and DVD's

MDA continues to work with a professional photographer to expand on our "Sound Book." Sound Books bring the story of Maryland's farmers to the consumer; it's a photographic slideshow with narration from the farmer. Fruits and vegetables and produce buyers were profiled in the sound books. The books were placed on Maryland's Best website and shown in some grocery store chains and trade shows. The images and sound are of high quality and it made an attractive promotional item. The 2014 soundbook that was funded through this grant was for Fox Meadows, a [specialty crop farm growing hydroponic cucumbers](#). This was far less than 20% of the budget.

Grant Funds for Specialty Crops Only

Funds from this grant are used to enhance sales of specialty crops only. More than half of the vendors of the Buyer-Grower event were specialty crop producers. The non specialty crop producers were funded by general state funds. The Department used funds from another project to augment the existing Maryland's Best advertising campaign of specialty crops for apples, pumpkins and Christmas trees.

GOALS AND OUTCOMES ACHIEVED

Goal	Outcomes
Increase visits to Maryland's Best Web site	The goal was to have at least 164,759 visitors to the site. Currently there have been 216,186 visitors to the site, which far exceeds our goal.
Increase searches on Maryland's Best Web Site for specialty crops	<p>In 2014 to date we have received the following number of users searching for specialty crops: Apples – 533, Cantaloupe – 19, Christmas Tree – 149, Flowers – 108, Fruits – 355, Corn – 110, Herbs – 88, Nurseries & Garden Centers – 101, Peaches – 201, Plant – 35, Pumpkins – 189, Strawberry – 218, Watermelons – 111, Wine – 76, Vegetables – 354.</p> <p>In 2014 there were a total of 2,647 specialty crop specific searches</p>

	<p>on the MD's Best web site.</p> <p>Apples – 526, Cantaloupe – 26, Christmas Tree – 269, Flowers – 225, Fruits – 432, Corn – 98, Herbs – 84, Nurseries & Garden Centers – 313, Peaches – 253, Plant – 62, Pumpkins – 361, Strawberry – 710, Watermelons – 142, Wine – 55, Vegetables – 792.</p> <p>As of this report there were a total of 4,348 specialty crop specific searches on the MD's Best web site.</p> <p>This increase of 1,701 searches exceeds our goal of a 5% increase in searches from 2014 to 2015.</p>
Increase mobile traffic to Maryland's Best Web Site	We have designed a new mobile responsive Maryland's Best site. In 2013 we received 5,391 mobile visits and aimed to have a 5% increase at 5,660. In 2014 to date the site has received 12,031 mobile web visits, which exceeds our goal.
Maintain/Increase access of specialty crop producers to diverse marketing channels	We have met our goal of maintaining and expanding our buyer-grower expo buyers from 146 in 2013 to 184 in 2014 registered.

After careful consideration, MDA decided not to attend PMA Fresh Summit in 2014. We were unable to get any specialty crop farmers to attend and the costs of exhibiting in California outweighed what we expected to gain from it. We instead have been meeting with wholesale buyers in and around Maryland to discuss specialty crop promotions and sales.

While the Buyer-Grower Expo registration was at an all time high for the 2014 event, due to a heavy snow storm the night before the event, attendance was lower than expected. What we found was that many of the dedicated buyers still attended and all of the specialty crop producers stated that they found the event to still be productive even with the low attendance.

BENEFICIARIES

Maryland's Best specialty crop activities are designed to promote and assist all Maryland producers of the state's major specialty crops. Advertising specifically directs consumers to the Maryland's Best web site which contains nearly 800 specialty crop producers in the state. The Buyer-Grower Expo had 40 specialty crop growers exhibiting that connected with wholesale buyers throughout the region. . These include growers of fruits and vegetables such as watermelons, various berries, apples, collards, kale, wine grapes, cucumbers, and squash, among many others.

LESSONS LEARNED

A major lesson learned during this grant period is that it is extremely important to have a user friendly web site with mobile capabilities. Once the Maryland's Best web site was redesigned we observed that the number of visitors increased, especially those using mobile. In addition, those

visitors were spending more time on the web site searching for specialty crops and learning about specialty crop promotions and producers. We also received an increase in the amount of visitors returning to the web site to use it again to search for specialty crops. These increases to the site in turn increase the amount of consumers who go to the site because of specialty crop advertising and ultimately purchase Maryland grown specialty crops.

Another lesson learned is that attendance does not reflect the success of an event. While our attendance at the 2014 Buyer-Grower Expo was down due to a snow storm, we found that those who attended were extremely dedicated to specialty crop sales and purchasing. Surveys taken after the expo show that the majority of specialty crop producers made connections that will lead to sales and that there was more time to spend one on one with wholesale buyers.

CONTACT

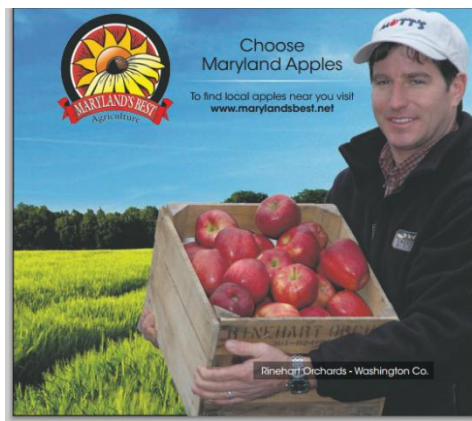
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ADDITIONAL INFORMATION



FINAL REPORT

Project Title: Reducing the Barriers Facing Maryland Fresh Fruits and Vegetables Producers in Implementing an Effective Food Safety Program (GAPS)

PROJECT SUMMARY

Buyer requirements for compliance with food safety standards and the Food Safety Modernization Act Produce Rule has become one of the most challenging issues facing fruit and vegetable growers. Previously identified barriers to obtaining the GAP certification include the cost to develop and implement food safety programs, lack of available technical assistance and training; and certification costs. Evaluations/surveys conducted pre and post attendance at GAP trainings have indicated this is still the case. This grant provided funding to build on previously funded Specialty Crop grant projects to continue providing the tools needed by growers to meet food safety challenges. The one to one assistance in developing and implementing a food safety program, training sessions, GAP inspections and certification of compliance, and cost share for USDA GAP audit fees provided to specialty crop growers with funding from this grant have assisted them in implementing best practices for food safety and obtaining GAP certification as necessary to meet their buyers requirements.

PROJECT APPROACH

Provide a dedicated position at the University of Maryland to continue providing educational sessions on GAPs, develop fact sheets and providing one to one technical assistance in writing and implementing GAP programs to fruit and vegetable growers. Increase the number of specialty crop growers attending training sessions.

Train adequate staff and maintain qualifications of existing staff to conduct MDA GAP inspections and USDA Harmonized GAP audits to maintain efficiency.

Inspect fruit and vegetable farms to verify compliance with the MDA GAP program and issue certification to assure buyers of specialty crops that the food safety practices are being followed. Increase the number

Provide cost share of certification fees to fruit and vegetable producers obtaining USDA GAP or USDA Harmonized GAP certification.

Adjust training sessions and MDA GAP certification requirements as necessary to comply with the Food Safety Modernization Act Produce Rule.

Conduct outreach to specialty crop producers on the resources available to develop and implement a GAP program.

GOALS AND OUTCOMES ACHIEVED

The dedicated position at the University of Maryland (UMD) coordinated four regional training sessions during this project with 130 attendees. 770 specialty crop growers attended training sessions funded by previous projects bringing the total growers trained at the end of this project

to 900. The UMD position also provided five mini training sessions during this project period with approximately 100 farmers attending (average of 20 at each session). The MDA Program Manager also provided ten mini sessions with approximately 200 farmers in attendance. Both the Basic GAP training sessions and the mini training sessions included information on the FSMA Produce Rule. The baseline for attendance was 350 farmers and the target was 600 farmers. We have exceeded the target number of farmers we hoped to train with funding from this grant and previously funded grants that we built on during this project period. Evaluations of pre and post training knowledge indicate growers benefit from the training sessions (detailed analysis of evaluations, pre test and post test score under Additional Information). The evaluations completed at the training sessions include a pre course and post course test. The average score on the pre course test was 52.4% correct and on the post course test the average score was 77.1% indicating a significant knowledge gain. 83% of the attendees indicated they were encouraged to write and implement a food safety plan after attending the training. 84% of the attendees post test scores indicated a gain in knowledge, 4% showed no change and 1% had a lower score on the post test than the pre test exceeding the project's goal of 80% of attendees reporting an increase in GAP knowledge.

One to one assistance by the UMD position has been provided to 302 specialty crop growers with previous grant funds. An additional 86 specialty crop growers received one to one assistance funded by this grant bringing the total to 388 specialty crop growers receiving one to one assistance in developing food safety plans. An additional 130 specialty crop growers received Cornell's Worker Training DVD, hand washing signs, and bathroom use signs. The baseline for this grant was 117 growers receiving assistance and the target was to assist an additional 200 growers. Using funds from this grant and previously funded grants the target has been exceeded.

Improper composting and a lack of understanding of the process for composting was identified as a problem for growers. Many thought that aged manure was composted and perfectly safe to use on vegetable crops. A fact sheet explaining compost and directing growers to resources to learn how to compost properly was developed by the UMD position. (Attached)

Two new inspectors/auditors attended the Cornell On line GAPS Produce Safety course and were trained through mentoring inspections by experienced inspectors/auditors. Four existing inspectors/auditors attended further education courses on line and in person including two that attended the ISO Lead Auditor training and are now licensed by USDA as lead auditors. Attendance at these training sessions allowed MDA to meet its goal of increasing the number of qualified inspectors/auditors and maintaining the qualifications of existing inspectors/auditors.

Initial, follow up and renewal inspections/audits of 38 specialty crop growers were conducted during this grant period and all of the growers inspected were in compliance with the MDA GAP requirements and received certification. The baseline for MDA certified growers was 20 and the target was 200. We did not reach the target of 200 specialty crop growers achieving MDA GAP certification during this project however the number of growers obtaining certification continues to grow each year and we anticipate a continued increase as Maryland specialty crop growers increase their sales to grocery chains and restaurants that promote local produce. Feedback from specialty crop growers indicate they are implementing food safety plans based on the knowledge

they gain from the training sessions but are not requesting inspection until a buyer requires certification.

Although we did not meet the target of 40 Maryland fruit and vegetable becoming USDA GAP/USDA Harmonized GAP during this grant period, we did increase the overall number receiving certification. The baseline was 20 growers and during this project period 30 different farmers obtained certification. Currently there are only 20 growers USDA GAP/USDA Harmonized GAP certified as several have been required by their buyers to obtain the Global Food Safety Certification for GAP. Other farmers will drop out for a year and come back the following year depending on their crop/buyer demands. The overall outcome is that 30 farmers were able to obtain USDA GAP/USDA Harmonized GAP certification during this project period. Twelve fruit and vegetable growers received cost share funding to offset the audit fees charged for certification.

Funding for a consumer produce safety project was requested in a future grant proposal however MDA had the opportunity to collaborate with a University of Maryland Extension Consumer Specialist Agent and the Farmers Market Nutrition Program to begin a consumer education program. At training sessions and meetings, specialty crop growers selling at Farmers Markets have indicated consumers are not cognizant of handling produce safely (putting it in dirty bags they bring with them, multiple customers handling the produce, etc.). These same farmers have indicated if they tell the consumer to wash their produce before eating, the consumer assumes something is wrong with their produce and will put it back and buy from another farmers. In response to the need to have a consumer education program that does not cause them to assume an individual farmer's produce is not safe we began with a Wash your Produce trial. Funding from this grant was used to design and a "Wash Your Produce" sign (attached). Funds from other sources were used to develop a survey for consumers reaction to the sign and provide a produce scrub brush at the farmers markets. The sign was tested at four farmers markets during this past season and consumers were surveyed to determine the effectiveness of the message. The survey results are still being compiled and depending on the results the sign will be more widely distributed or revised to be more effective. Initial feedback from specialty crop growers in these markets indicate the sign and scrub brush were effective in educating consumers without leading the consumer to believe there was something wrong with their produce. Future work on this project will be funded by other grants. The Department used the remaining funds from another project to augment the existing project Reducing the Barriers Facing Maryland Fresh Fruits and Vegetables Producers in Implementing an Effective Food Safety Program (GAPS) for cost-share GAP audit costs for producers, food safety training materials, training travel and contractual salaries and fringe.

The beneficiaries of this project include 130 fruit and vegetable growers that attended Basic GAP and Advanced GAP training; 30 fruit and vegetable growers that obtained USDA GAP/Harmonized GAP certification; 38 growers that obtained MDA GAP certification; and 60 growers selling at four different farmer's markets where the consumer education sign was piloted.

LESSONS LEARNED

Attendees at the training sessions and those that obtain one to one assistance with writing and implementing a food safety plan are unlikely to obtain certification unless their buyers require it.

The educational piece of this program has still been very valuable to the majority of attendees as they have implemented GAP and improved their food safety practices. This has been verified by reviewing the comments and responses to the post training survey (attached), talking to specialty crop growers and on farm visits. Growers that have moved on to Global Food Safety Initiative certification as required by their buyers have indicated they would not have been able to accomplish that type of certification without participation in the training sessions and obtaining the MDA GAP and/or USDA GAP certification first. We anticipate increased participation now that the FSMA Produce Rule has been finalized.

Buyers frequently change the type of GAP certification they require. MDA has talked directly to buyers with many of the grocery store chains that are interested in buying local to inform them of the MDA GAP requirements. Once they realize fruit and vegetable growers that are certified by MDA are following best practices for food safety they are more inclined to accept MDA certification especially as a stepping stone to USDA GAP/USDA Harmonized GAP or Global Food Safety Initiative certification.

Evaluations of training sessions were compiled and analyzed to evaluate the effectiveness of the program and make necessary changes. Based on the evaluation survey, the training sessions have met the needs of attendees. The need to change the training and the MDA GAP inspection/audit to meet the FSMA Produce Rule requirements is indicated and will be done using funds from other grant projects.

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ADDITIONAL INFORMATION



Composting Basics

Justine Beaulieu, University of Maryland
April, 2016

WHAT IS COMPOSTING?

The controlled decomposition of organic matter into a stable, humus-like product called compost. It is essentially the same process as natural decomposition except that it is enhanced and accelerated by mixing organic waste with other ingredients to optimize microbial growth. The process involves careful monitoring of your compost pile, particularly measuring its temperature and turning it.

There are two types of composting piles: Hot and cold. A "hot pile" requires more attention, but decomposes faster than a "cold pile." Due to its size and composition, the center of a hot pile reaches temperatures between 140 and 180 degrees F, creating optimal conditions for decomposition and the elimination of harmful plant and human pathogens. A cold pile relies on the forces of nature to eventually decompose.

For "hot piles", maintaining that optimal temperature range is very important. Turning your pile will be necessary for keeping the temperature below 180 degrees F and for exposing your pile to more oxygen. More instructions on how to properly compost can be found at http://mda.maryland.gov/resource_conservation/Documents/tip4.pdf

WHAT IS MANURE?

Animal waste used for fertilizing land.

SO THEN...WHAT'S COMPOST?

Compost is the stable, humus-like product created by composting any type of organic matter, including yard waste and manure. NOTE: Manure and other animal products should not be composted using the "cold pile" method, as the high temperatures required for pathogen elimination are not reached. If composted properly, there should be no pathogens in your decomposed manure.

WHAT'S THE DEAL WITH AGED MANURE?

Aged manure is manure that has been left to sit for a long period of time. Aging manure does not eliminate pathogens.

GUIDELINES FOR FERTILIZING

There are a lot of different guidelines out there. For farmers aiming to satisfy National Organic Program, Good Agricultural Practices, and/or Produce Safety Rule standards, the use of compost versus manure will affect how long you have to wait between application of the fertilizer and harvest. See Table 1.

Amendment	Contact with Produce?	Time Interval
Compost (includes composted manure)	Contact	0 days
Compost (includes composted manure)	No contact	0 days
Manure	Contact	120 days
Manure	No contact	90 days

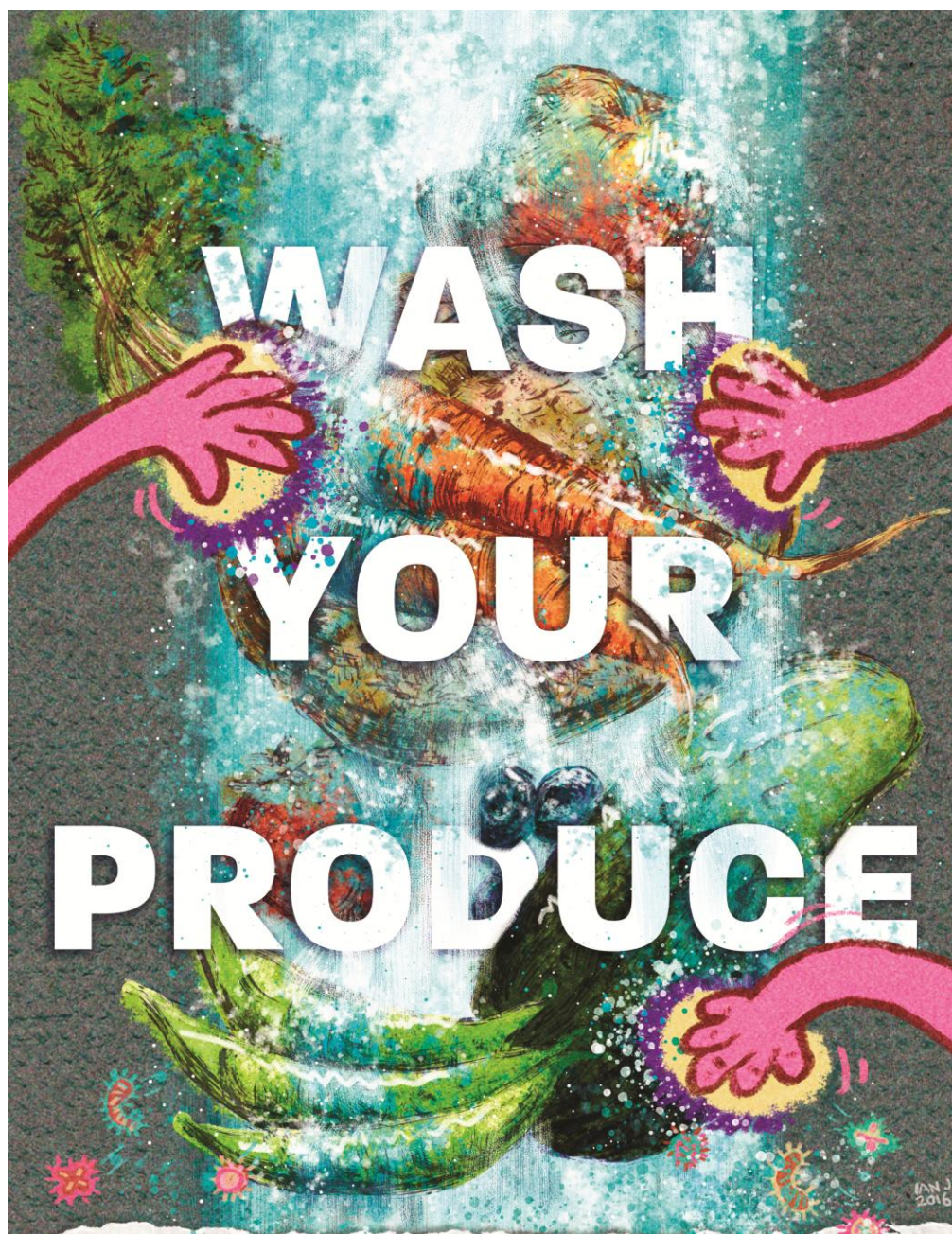
Table 1. National Organic Program standards

RISKS ASSOCIATED WITH COMPOSTING

Improperly composted manure, blood meal, animal-based food scraps, and other animal products may still harbor human pathogens that could cause disease. Composting animal products properly is important for food safety. Contact your local University Extension Office with any questions. When purchasing compost, be sure that it comes from a licensed composting facility that is following and documenting proper composting procedures.

REFERENCES

1. Maryland Department of Agriculture. Compost. Title 6. Chapter 04. Online. 2014. www.dsd.state.md.us
2. Shell, L. "Backyard Composting." University of Maryland Extension, Home and Garden Information Center. 2005. Web.
3. "Try Composting." Fact sheet. Maryland Department of Agriculture. Annapolis, MD. December 15, 2015. Web.
4. USDA NRCS. "Composting." *Environmental Engineering National Engineering Handbook*. 2000. Online.



Why wash your produce?

- All produce, both organic and non-organic may have soil and germs that can make you sick.
- Note—you are not the only one touching produce: Other shoppers...



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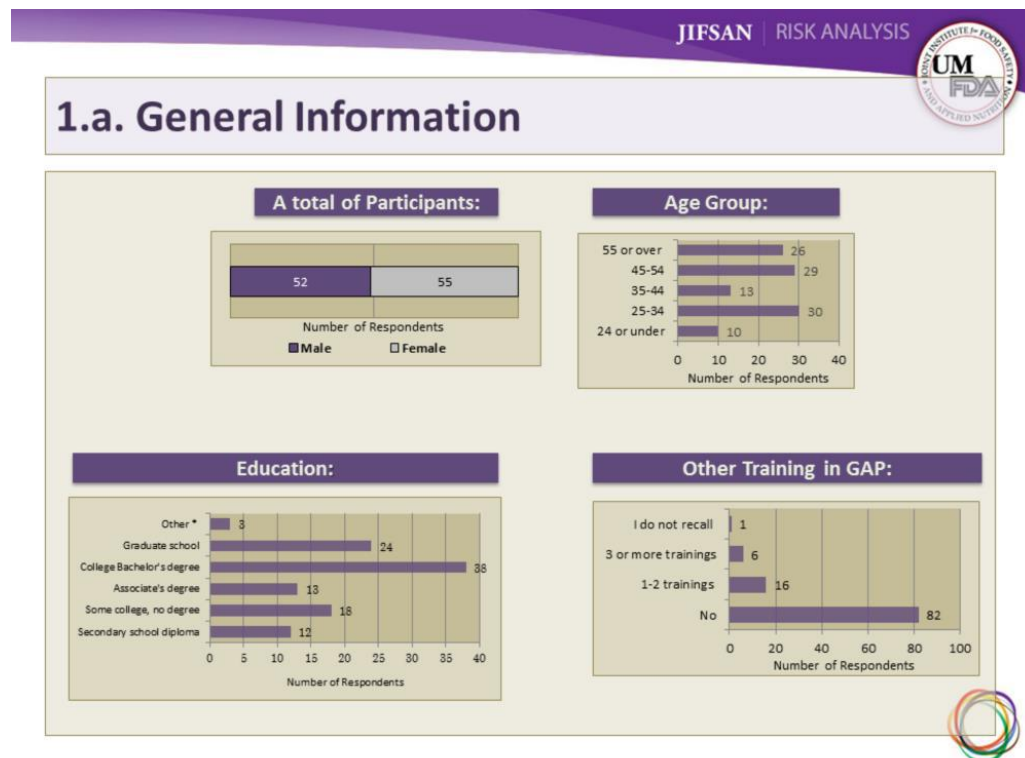
How to wash:

- Do not use chlorine bleach or soap—they are not meant to eat.
- Washing with clean water is the best practice.
- Wash produce right before eating or cooking.

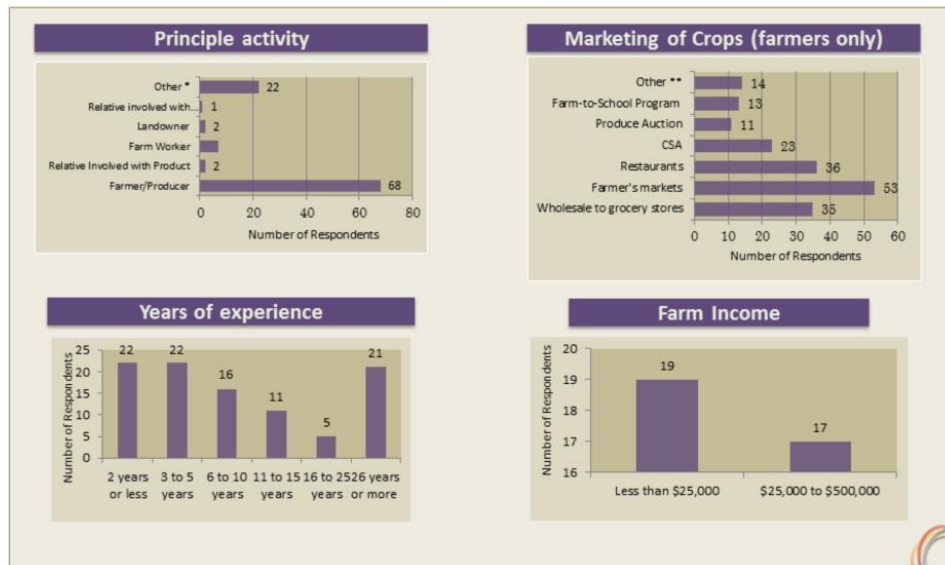
Clean Produce=Fresh Flavor!



Other: Master's +30, PhD, Trade school certificate



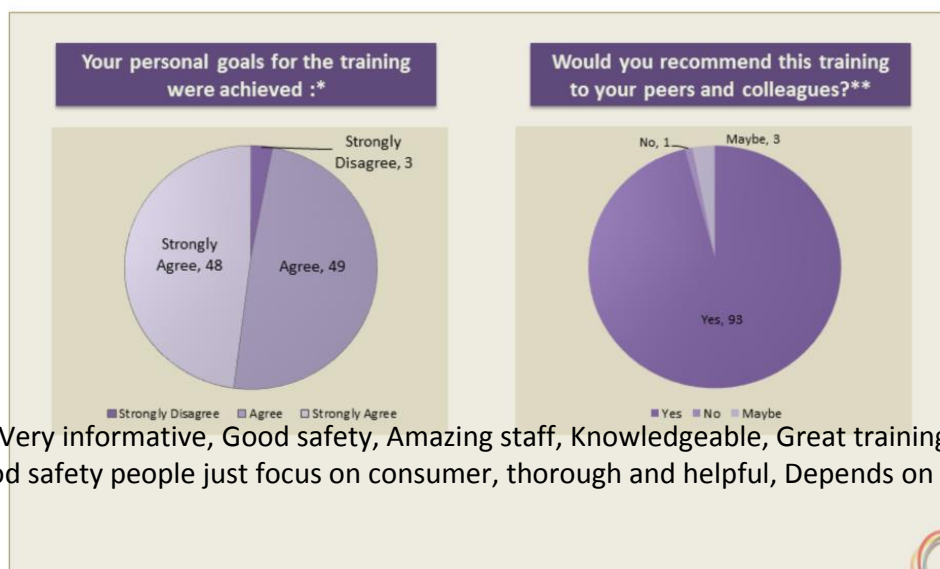
1.b. General Information



*: Other Primary Functions: 1-Farm Chef, 2-Community Gardener, 1-Extension Agent and Gardener, 2-Farmer Assistant, 1-Student, 1-UME Educator, 1-State Health Department, 1-Farmer in Training, 1-Farmer to be, 1-Pursuing NM Consultant (Farmer to be), 1-I.T. Consultant, 1-Part time farmer, 3-Non-profit, 1-Educator, 1-Representative of Producer/Farmer.

** : Other Marketing of Crops: 3-On Farm Market, 4-Direct Farm Market, 7-Roadside Market, 1-Online Sales, 4-Wholesale to other markets, 1-Upick, 2-Community, 1-on-farm stand, retail delivery to local residents, 1-word of mouth, 3-Non-profit, 1-Food banks, 1-TBD (first year farming)

2. General Satisfaction



*:Why?: Very informative, Good safety, Amazing staff, Knowledgeable, Great training, good format, some food safety people just focus on consumer, thorough and helpful, Depends on Position

3. Detailed Satisfaction—Training & Instructor



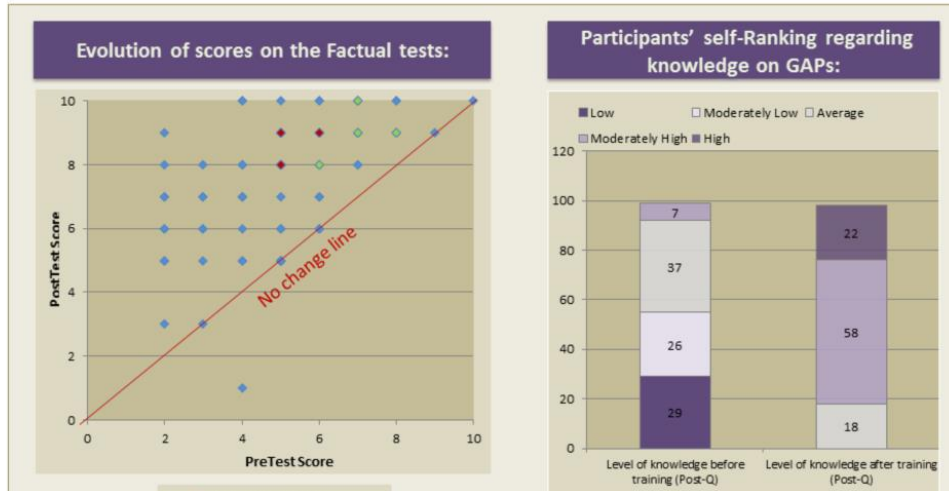
3. Detailed Satisfaction—Training & Instructor



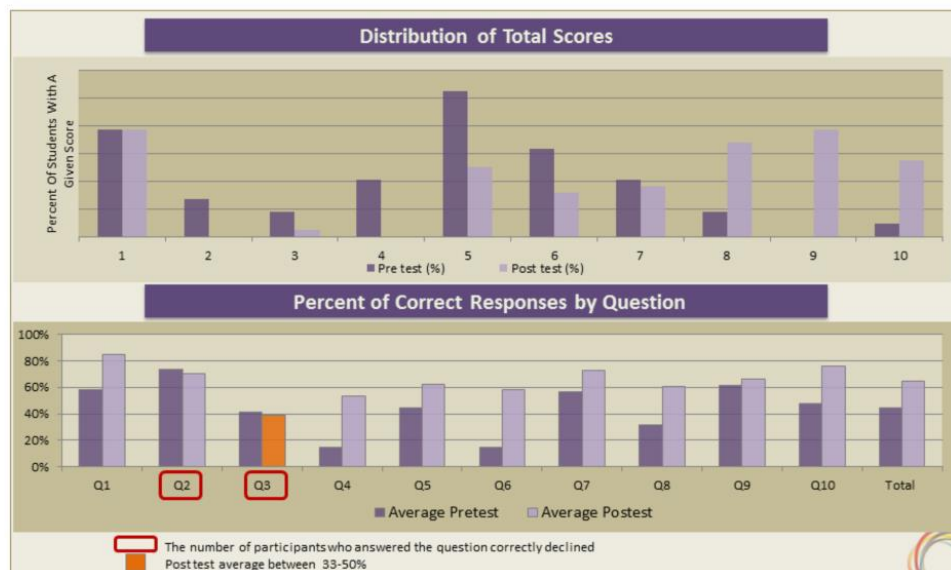
Average score on Pretest: 52.4%100 participants
 Average score on Posttest: 77.1%100 participants
 Change in average (using participants with both pre and posttest): 2.49
 Percentage scoring 75% or more on the Pretest: 6%(6out of 88)
 Percentage scoring 75% or more on the Posttest: 50%(44 out of 88)



4. Learning – Factual Tests And Self Ranking



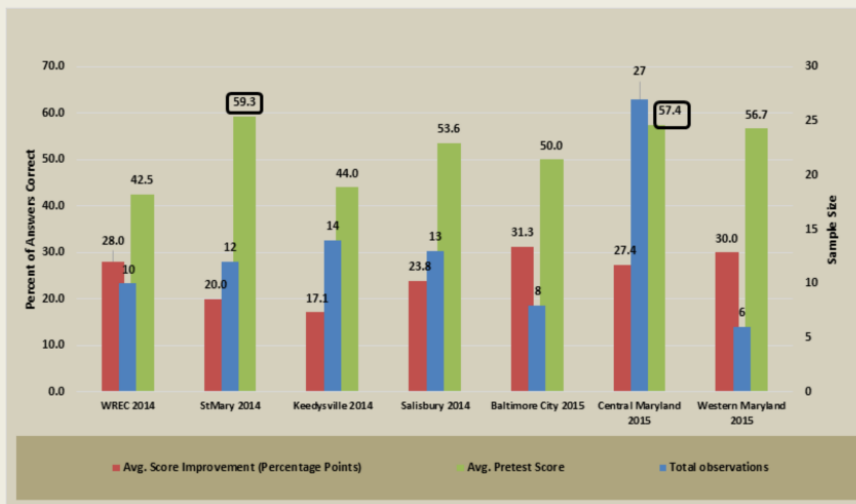
4. Learning – Analysis Of Pre-Test & Post-Test



4. Learning –Analysis With Pretest & Posttest

Question	Q3
Organic fertilizers can be treated to reduce microbiological risk. Which of the following treatments is the least likely to be effective?	(1) Heat treatment (2) Aerobic composting (3) Inactive composting * (4) All of the above (5) I am not sure if the answer
(1) Heat treatment (2) Aerobic composting (3) Inactive composting (4) All of the above (5) I am not sure if the answer	
Answer	3

4. Performance by training group

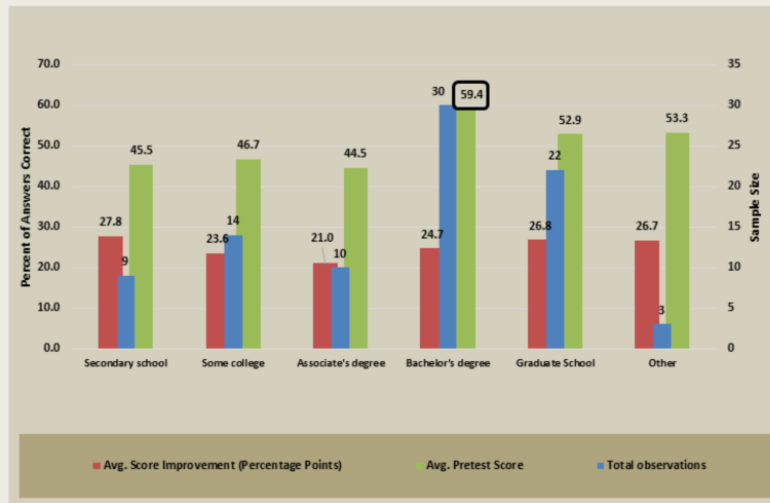


A multiple regression, including only dummy variables for each of these groups as independent variables –as well as pre-test scores, when assessing changes in pre-and post-test scores, reveals:

- The higher pre-test scores for the St. Mary's County, 2014 group to be statistically significant (relative to the first dataset, WREC 2014)
- No statistically significant differences in test score improvements, once pre-test scores are controlled for

Circled numbers denote these statistically significant differences.

4. Performance by education

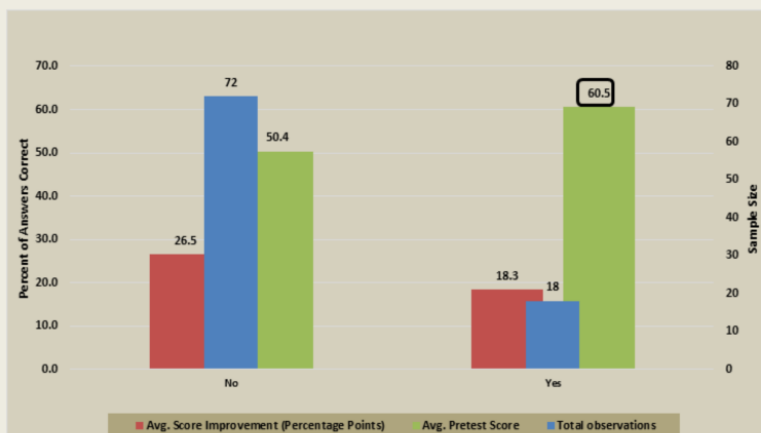


A multiple regression, including only dummy variables for each of these groups as independent variables –as well as pre-test scores, when assessing changes in pre-and post-test scores, reveals:

- The higher pre-test scores for the participants with a Bachelor's Degree to be statistically significant (relative to the first group, Secondary School)
- No statistically significant differences in test score improvements, once pre-test scores are controlled for

Circled numbers denote these statistically significant differences.

4. Performance by previous training

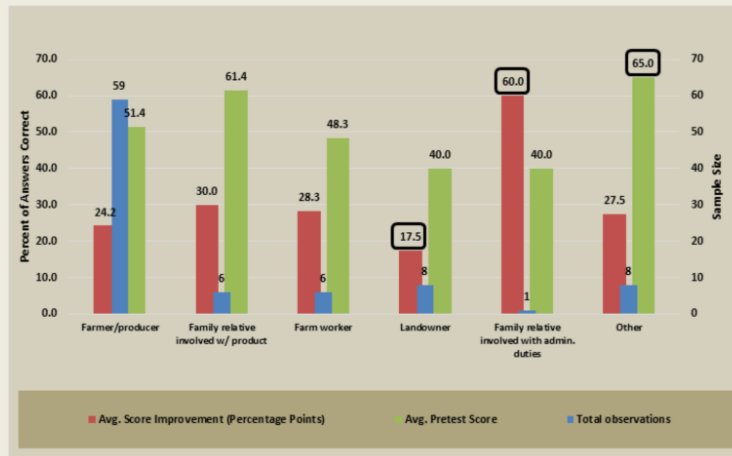


A multiple regression, including only dummy variables for each of these groups as independent variables –as well as pre-test scores, when assessing changes in pre-and post-test scores, reveals:

- The pre-test scores for the participants with previous training to be significantly higher than the scores for those without previous training
- No statistically significant differences in test score improvements, once pre-test scores are controlled for

Circled numbers denote these statistically significant differences.

4. Performance by principal activity



A multiple regression, including only dummy variables for each of these groups as independent variables –as well as pre-test scores, when assessing changes in pre-and post-test scores, reveals:

- The higher pre-test scores for the “other” group to be statistically significant (relative to the first group, family/producer)
- The differences in test score improvements (relative to the first group, family/producer) to be significantly lower for the landowner group, and higher for the “family relative involved with admin duties” group (although the sample size is arguably insufficient to draw an inference), once pre-test scores are controlled for

Circled numbers denote these statistically significant differences.

4. Performance by time spent farming



A multiple regression, including only dummy variables for each of these groups as independent variables –as well as pre-test scores, when assessing changes in pre-and post-test scores, reveals:

- No statistically significant differences in pretests scores among the groups
- No statistically significant differences in test score improvements among the groups, once pretest scores are controlled for

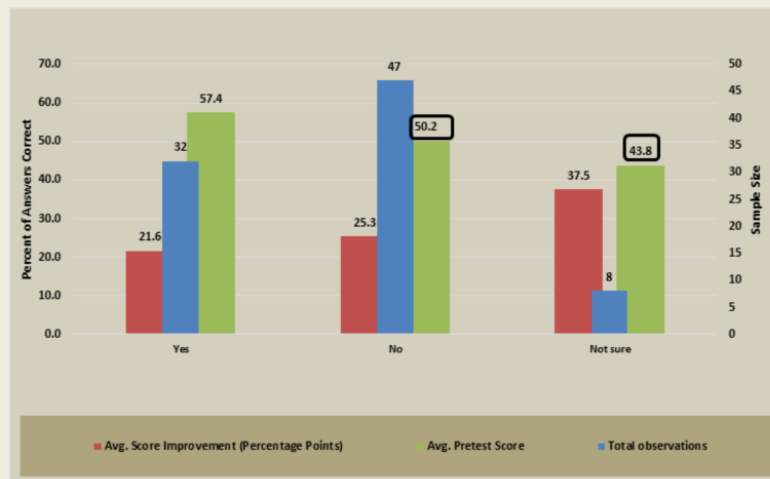
4. Performance by farm income



A multiple regression, including only dummy variables for each of these groups as independent variables –as well as pre-test scores, when assessing changes in pre-and post-test scores, reveals:

- No statistically significant differences in pretests scores among the groups
- The higher differences in test score improvements for the \$25-\$500K group (relative the first, lowest income group) to be statistically significant, once pretest scores are controlled for

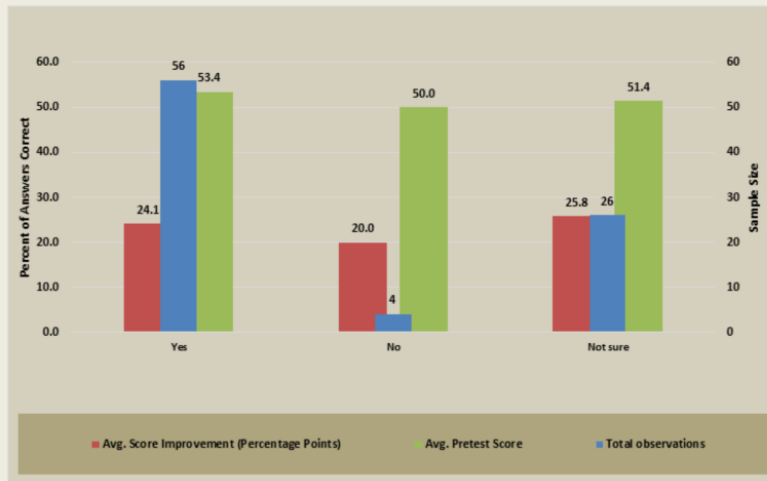
4. Performance by certification requirement



A multiple regression, including only dummy variables for each of these groups as independent variables –as well as pre-test scores, when assessing changes in pre-and post-test scores, reveals:

- The lower pretest scores for those who do not need, or do not know if they need, certification to be significantly lower (relative to the first group, those needing certification)
- No statistically significant differences in test score improvements among the groups, once pretest scores are controlled for

4. Performance by whether will be affected by FSMA



A multiple regression, including only dummy variables for each of these groups as independent variables –as well as pre-test scores, when assessing changes in pre-and post-test scores, reveals:

- The lower pretest scores for those who do not need, or do not know if they need, certification to be significantly lower (relative to the first group, those needing certification)
- No statistically significant differences in test score improvements among the groups, once pretest scores are controlled for

4. Performance by self-assessed pre test knowledge (answered post test)



A multiple regression, including only dummy variables for each of these groups as independent variables –as well as pre-test scores, when assessing changes in pre-and post-test scores, reveals:

- The higher pretest scores for the average group to be significantly lower (relative to the first group, low)

-No statistically significant differences in test score improvements among the groups, once pretest scores are controlled for

4. Performance by primary reason for attending training

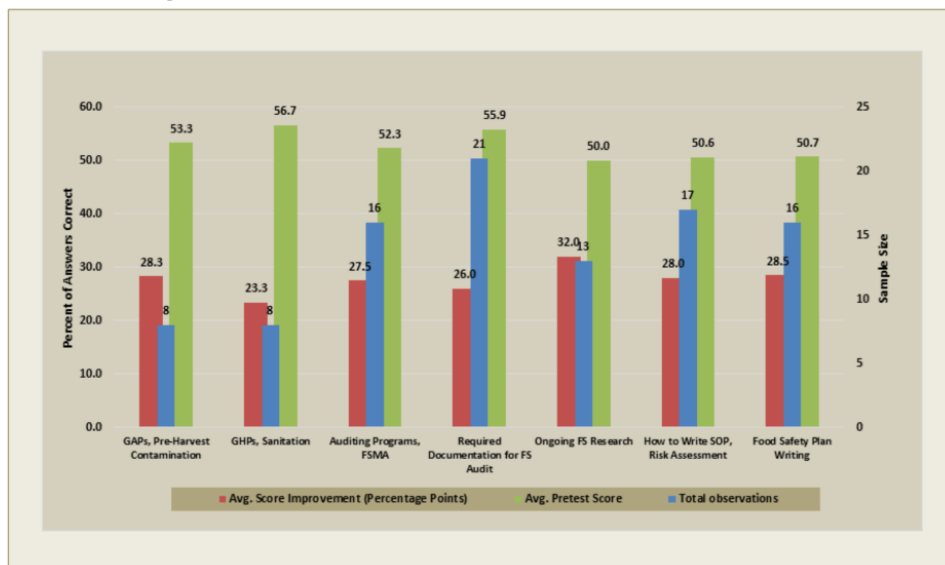


A multiple regression, including only dummy variables for each of these groups as independent variables –as well as pre-test scores, when assessing changes in pre-and post-test scores, reveals:

-The higher pretest scores for the average group to be significantly higher (relative to the first, lowest group)

-No statistically significant differences in test score improvements among the groups, once pretest scores are controlled for

4. Performance by ability to apply current skills in select topics



A multiple regression, including only dummy variables for each of these groups as independent variables –as well as pre-test scores, when assessing changes in pre-and post-test scores, reveals:

- No statistically significant differences in pretest scores among the groups
- No statistically significant differences in test score improvements among the groups, once pretest scores are controlled for

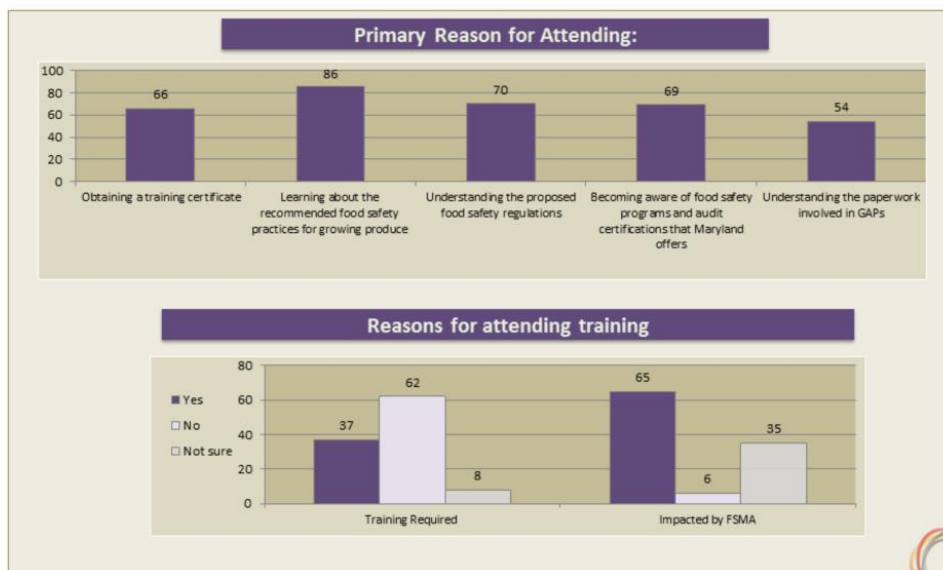
5.a. Training Needs



*:Other: Farm to school regulations/plans for Maryland

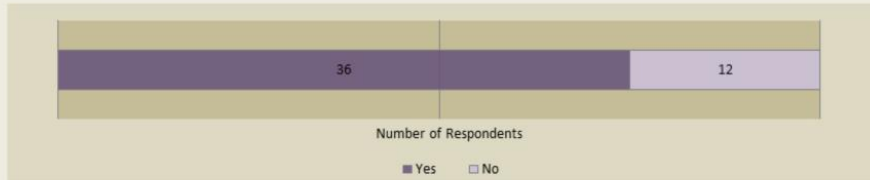


5.b. Expectation & motivation



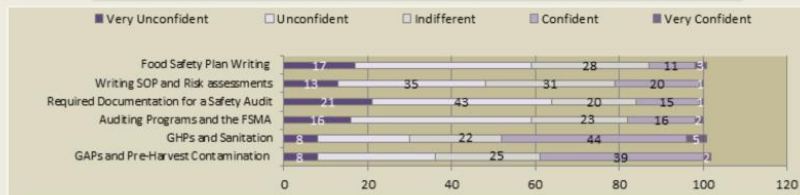
5.b. Expectation & motivation

Encouraged to Write a Food Safety Plan and Apply for Certification:

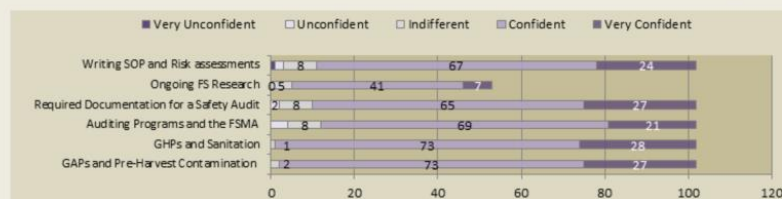


6. Ability to evaluate

Ranking the Ability in Applying the New Skills – Before Training



Ranking the Ability in Applying the New Skills – After Training



No students reported being “Very Dissatisfied” and only one reported being “Dissatisfied” with the different training segments. Few students (1-4) reported being “Indifferent” , and most reported either being “Satisfied” or “Very Satisfied”.

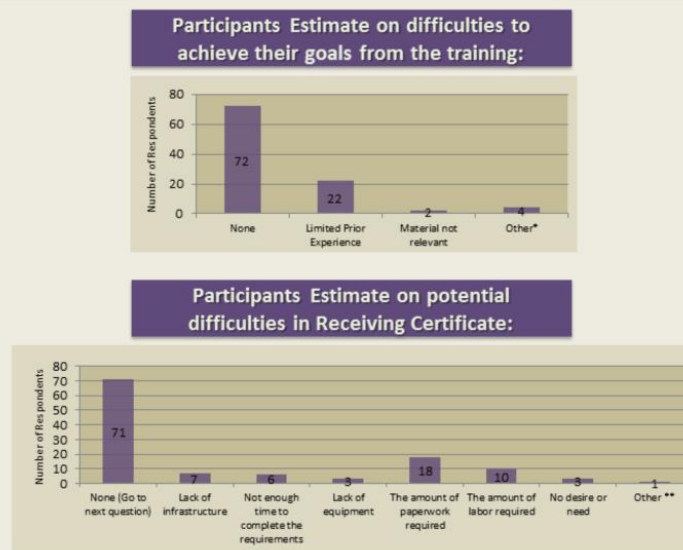
No students reported being “Very Unconfident”. Most students reported being “Confident” or “Very Confident” . Few students (1-5) reported “Indifferent” (Questions 1=4, Question 2=4, Question 3=5,

Question 4=5, Question 6=1), while only 1-2 reported being “Unconfident” (Q1, Q2, Q3, Q4).

6. Future planning (Post evaluation)



7. Barriers & Difficulties (Post evaluation)



*: Other: a lot, lack of farm ownership to prepare plans, \$ in implementation, room was cold! Not enough time, Specifics to Baltimore urban farmers were limited, Lots of material crammed into a short time, Computer failure, Time

** : Other: no farm, Time, Too small an operation, existing operation infrastructure layout, Time, Too small operation, Existing operation's infrastructure layout



8. Comments – (Post Evaluation)

11. Did this training encourage you to write a food safety plan and apply for a food safety certification?

(Yes=83)

- May
- May
- May-14
- June
- June
- April
- June
- May
- 1-Aug
- May or June
- April/May
- May-June
- May/June 2014
- 42036
- March
- March or April
- Feb
- March
- March
- March-April
- In one year
- ASAP
- April
- April
- not sure
- not sure
- when necessary
- May
- Jun-16
- already completed
- Jan-00
- Fall
- 12-Jun
- April
- 6 months
- Not sure yet
- July
- April
- 15-Apr
- 15-Apr
- April
- Aug
- Probably next year
- May-15
- September
- May
- 2015/16
- 2015
- Immediately
- May-15
- June
- Fall/Mid Summer
- July
- May
- September
- April

8. Comments – (Post Evaluation)

11. Did this training encourage you to write a food safety plan and apply for a food safety certification?

(No=14)

- not a farmer
- not required
- Too Busy
- not need currently
- I don't currently have a gardening/farming space.
- I will do a plan but don't need the cert - I will be working with a school ... maybe later
- Already have one
- I will have a plan written for reference as a safety precaution - I am too small for certification
- No farm
- Don't own/have a farm/garden
- Not big enough yet to apply for certification (Producing enough)
- At this time some requirements are not feasible for us.
- Distribution does not require it.



8. Comments – (Post Evaluation)

13. What parts of the workshop did you find to be the most useful to your farming operation?

- The pre- and post-harvest application ideas, studies, research, and findings were very useful to think about.
- Writing the plan at the meeting.
- Everything was very useful to me, very informative.
- Everything was very useful.
- 4 W's.
- The hands on activities as well as examples from other farms.
- The different levels of GAP. I thought that was the same for every farm.
- Whole course helpful. Thank you.
- The binder and flash drive
- It was all helpful
- Everything
- Everything
- The USB Drive to start plan
- It was all helpful. The walkthroughs with paperwork and examples were specifically helpful.
- One on one time
- One on one assistance, "Workshop" Time, Laptops available w/ flashdrive
- Food Safety Plan Template
- Plan writing
- The part that pointed out the areas of concern about safely growing and marketing fresh produce.
- This was a great review for me to be confident my practices are on target.
- FSMA Overviews
- Personal Assistance by Kathy
- All aspects
- Going over different types of contamination, necessary to get certified- paperwork
- All facets of training were beneficial with well-informed educators
- Breakdown of various certification chlorine and water specifics
- Very hands on, good organization
- 4 W's! Post-harvest sanitation.
- Q&A
- All
- GAP/GHP, FSMA, Good to understand what we're doing right/wrong and how we can improve
- Review of writing the food safety plan
- School Garden
- The writing of the plan
- The entire training
- All components were good and necessary
- All of it
- Well done

8. Comments – (Post Evaluation)

13. What parts of the workshop did you find to be the most useful to your farming operation? (continued)

- MDA audit
- Packaging
- Actually working on a plan on computer
- Handling + Harvest
- 4 W's, Good Agricultural Practices and Pre-harvesting Contamination, Good Handling Practices + Sanitation
- material was helpful.
- All the talks - Q and A
- Many areas. Questions were answered and staff helpful
- Great presenters! Clear material
- the entire workshop was helpful to clarify and refresh my memory so I will be able to better advise the farm community in AA county.
- Potential ways to prepare for FSMA
- The use of common sense in your farming practices. The information on the GAP program.
- GAPs auditing program education, Food Safety and Water sanitation education, Employee sanitation suggestions
- General overview of GAP standards and specific examples
- Variety of speakers and detailed plans and resources.
- Instructors knowledge and helpfulness
- Plan writing exercises
- Coming in with no prior knowledge, I found it all quite helpful
- All of it - very helpful and interesting. Will help us to sell our produce to major grocers
- Plan Writing
- having someone to answer questions.
- Having someone available to answer questions about GAP certifications, laptops (loved this)
- Heads up for more gov. control.
- Where to get information: contact persons
- Template for food safety plan
- everything
- Fill in blank documents
- Simplifying plan organization
- Found it all useful
- Good progression of topics...ending up with writing part of plan
- The worksheets for the GAP documents, information about different levels of certification
- Auditing process
- Step by step instructions on how to apply it to my farm
- It all helped to fit my small mixed vegetable operation
- Assessing current practices, writing plan to access new market
- All parts good. Planning on becoming MDA GAP cert.
- Hands on one on one with Donna. Realistic info from Dr. Kneil. Dave martin handling and practice of produce.
- Clearing up misconceptions as to who needs to write up an SOP/GAP plan
- Food safety

8. Comments – (Post Evaluation)

14. Please provide us with any additional comments you would like to make about this training including suggestions for improvements.

- Great info overall. Again the most useful info are the research findings so that we can be sure our time and investment is being spent towards scientific findings that we know will make an impact on decreasing patterns and harmful bacteria.
- Pre-labeled dividers in the binder for SOPs & Risk Assessments so the binder could be used as the GAP binder.
- Keep up the good work. Enjoyed it!
- None, great workshop!!
- One guest was vegetarian and misunderstood the lunch menu. Left and came back with purchased food.
- Great job! So glad this wasn't someone reading PowerPoints for 6 hours. Healthier food, gluten-free and veggie options would be nice.
- Excellent! On my way to new adventures in Ag!
- Great workshop. Very complete information. Learned some new things. Covered a vast majority of topics. Great Resources! Well thought out and professional! Impressed! Glad I took this workshop. Thanks for all your work and help.
- Notifying farmers about additional training.
- Possibly make it two days or more. It is a lot to take in in one session. Otherwise it was great.
- Please offer vegetarian main course lunch items: egg salad sandwich or veggie split pea/lentil soup, salad w/quinoa, hummus wrap, rice/pasta & fresh veggies.
- Very good class, great training materials
- Hopefully the B.S. of Certification and plan writing doesn't get in the way of good agricultural practices
- Very thorough and organized. This was not a waste of time.
- Great!
- Have one in Montgomery County!!!
- Access to internet!
- Each farm is different so it's interesting to think how diverse plans can be.
- Thank you so much for helping me have more confidence in my fruit, produce and egg production! I want to be as safe as possible!
- Keep up the good work!
- Thanks! You guys did a great job!
- This is a much needed and necessary training which all growers should be aware of whether needing a certification or not... it definitely gives definition and direction.



8. Comments – (Post Evaluation)

14. Please provide us with any additional comments you would like to make about this training including suggestions for improvements. (continued)

- Thanks!
- Packaging
- N/A
- chairs
- Discussion - why? Case studies in implementation
- A vegetarian meal option
- Vegetarian meal option for lunch
- Great job! Thx
- Earlier setup.
- Definitely would have been more useful for my orchardist, but I will do my best to relate the information. Thanks so much!
- None - thank you!
- I don't think you need improvements
- Training was actually really good.
- None. Maybe examples of disinfect besides bleach.
- actual examples
- Stop using styrofoam plates and cups.
- Great work! Just what I needed
- Keep doing a great job.

FINAL REPORT

Project Title: Improve Packing Shed Food Safety Practices for Maryland Fruits and Vegetables (GHPS)

PROJECT SUMMARY

The Food Safety Modernization Act (FSMA) Produce Rule and several food borne illness outbreaks attributed to cross contamination of produce with pathogens during post harvest handling indicated a need to assist specialty crop producers in implementing better practices. Preventing food borne illnesses and compliance with FSMA are critical to specialty crop growers in maintaining/increasing their market share. The grant provided funding to identify best practices for post harvest handling; verify the effectiveness of the best practices; educate and assist growers with implementing the best practices; and assist growers with the costs of obtaining USDA Harmonized Post Harvest certification.

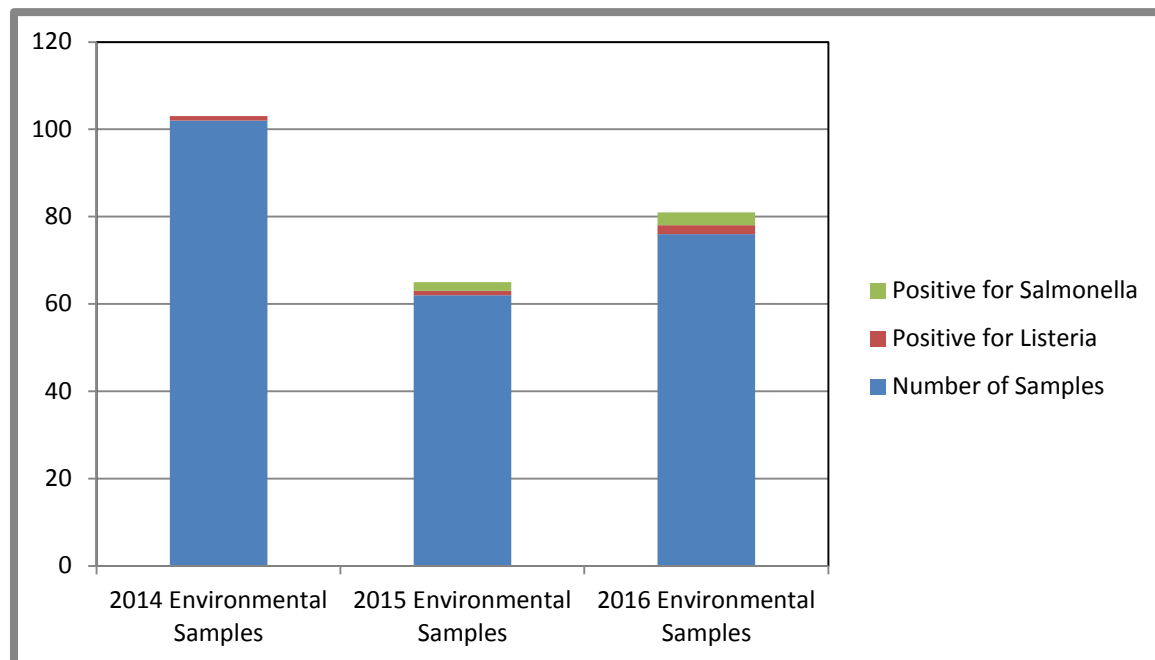
PROJECT APPROACH

Three Advanced Good Handling Practices training sessions were held with a total of eighty one growers attending. The curriculum (see attached agendas) included specific information on post harvest water quality and mitigation strategies; cleaning and sanitizing equipment and harvest baskets; and pathogens of particular concern. Two additional sessions were held with wholesale growers where information on cleaning and sanitizing equipment and post harvest water quality mitigation strategies were presented to seventy fruit and vegetable growers. Attendees at the training sessions consistently indicated they

Two publications, “Good Handling Practices Fact Sheet” and “Post Harvest Water Use and Sanitation Fact Sheet” (attached), were developed and distributed to fruit and vegetable growers at training sessions and meetings, through mailings and posted on the MDA and UMD websites. Growers have found the publications to be very useful in improving their post harvest handling practices.

Environmental sampling was conducted during 2014, 2015 and 2016 to verify the effectiveness of post harvest handling food safety practices. Harvest and packing equipment, water, coolers, harvest baskets, and other surfaces with the potential of contacting and contaminating produce were swabbed and analyzed for *salmonella* and *listeria*. The following chart summarizes the results of the sampling project.

Environmental Sampling Summary



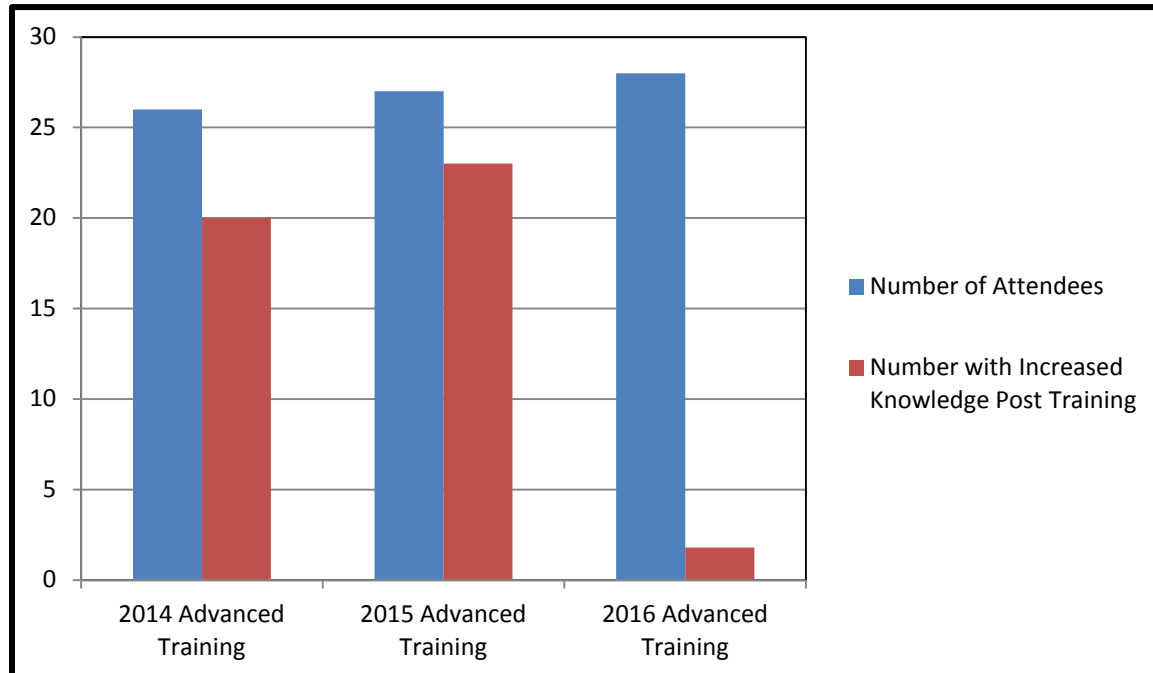
Good Handling practices of the producers with positive swabs were reviewed for effectiveness. The primary change implemented to prevent contamination in the packing house was improved cleaning and sanitizing procedures for equipment and harvest containers. This information was also used to develop the publications resulting from this project.

The MDA GAP audit was revised to include Good Handling Practices for Post Harvest packing and washing to encourage producers to implement best post harvest handling practices (see attached Good Handling Practices). Thirty two fruit and vegetable growers received the MDA certification.

Cost share assistance for USDA Harmonized Post Harvest certification audit costs was issued to encourage producers to obtain a higher level of post harvest certification. Three producers received cost share for USDA Post Harvest certification in 2014. An additional eleven producers obtained USDA Harmonized Post Harvest certification in 2015 and 2016 however they received cost share reimbursement for audit costs through another specialty crop grant.

GOALS AND OUTCOMES ACHIEVED

GOAL: Increase the number of MD farmers with enough knowledge to pass the audit and become USDA GHP/USDA Harmonized Post Harvest certified		
Benchmark	Target	Actual Performance
3	20	14
GOAL: Provide training and technical assistance on GHP to MD specialty crop producers with on farm packing sheds.		
Benchmark	Target	Actual Performance
Unknown	80% attending training report an increase in GHP knowledge	88% reported increase in GHP knowledge
GOAL: Increase the number of MD farmers that pass the MDA inspection to become MDA GHP certified		
Benchmark	Target	Actual Performance
0	80	32



The number of Maryland farmers issued USDA GHP Post Harvest Harmonized certificates has not met the goal. The benchmark was three Post Harvest Harmonized producers and that has only increased by fourteen instead of the target of twenty. However, the knowledge gained in the advanced training and through the publications assisted some of the producers in obtaining the Global Food Safety Initiative certification as required by their buyers.

The number of Maryland farmers obtaining the MDA GHP certification did not meet the goal. Thirty two fruit and vegetable growers obtained the certification. Many additional produce growers have used the training and publications to implement better practices in post harvest handling of produce but have not gone on to obtain certification.

BENEFICIARIES

The Specialty Crop growers that benefited from this project include the eighty one attendees at the Advanced Good Handling Practices training sessions in 2014, 2015 and 2016; seventy wholesale growers that attended MDA grower meetings in 2015 and 2016; and the specialty crop growers/packers that have access to the publications “Good Handling Practices Fact Sheet” and “Post Harvest Water Use and Sanitation Fact Sheet”. All funds from this grant were used solely to assist specialty crop producers.

LESSONS LEARNED

The timing of training sessions is critical to the attendance and implementation of best practices. Attendance is best when sessions are held in early spring and implementation of practices occurs immediately following the training.

Environmental testing and MDA GHP inspections revealed many packing houses were power washing equipment and harvest baskets with water and not using detergents and sanitizers. The assumption was if it looked clean there would be no pathogens. Once they received instructions on how to use detergents and sanitizers most of the produce growers began using better sanitation practices.

The majority of growers do not obtain USDA or MDA certification unless it is required by a buyer. Using the number of growers obtaining certification as a measurement does not accurately reflect the number of growers that have implemented better practices. From conversations with growers, we believe many have implemented the practices they have learned about in the training even though they have not become certified. The implementation of better practices will assist these growers in complying with the FSMA Produce Rule.

CONTACT

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410-841-5769

ADDITIONAL INFORMATION

Advanced Food Safety Training

50 Harry S. Truman Pkwy

Annapolis, MD 21401

April 23, 2014

9:00am to 4:00pm

8:45-9:00 am Coffee, Registration, and Self-Assessment

9:00-9:10 am Welcome

9:10-9:30 am FDA Current Authorities and Proposed FSMA Regulations

Deanna Baldwin, Maryland Department of Agriculture

9:30-10:00am Water Infiltration and Sanitation

Chris Walsh, Univ. of Maryland

10:00-10:45 am Good Handling Practices (GHPs) and Sanitation

Wes Kline, Rutgers University

10:45-10:55 am Break

10:55-11:20 am FDA Inspections and Environmental Sampling

Donna Pahl, Univ. of Maryland

11:20-12:10 am Traceability Programs and Performing a Mock Recall

Wes Kline, Rutgers University

12:10-12:40 pm Lunch

12:40-1:10 pm Water Sanitation Demonstration

Chris Walsh and Donna Pahl, Univ. of Maryland

1:10-1:40 pm “Experiences from the Auditor’s Notebook”

Deanna Baldwin, Maryland Dept. of Agriculture

1:40-2:15 pm Panel Discussion on GAP Audit Experiences

Dave Martin, Univ. of Maryland Extension, Baltimore County

2:15-4:00 pm- Optional: Risk Assessment and SOP writing, Plan-Writing

3:30-4:00 pm Questions, Wrap-up and Adjourn

Advanced Food Safety Training

50 Harry S. Truman Pkwy

Annapolis, MD 21401

March 20, 2015

8:30-9:05am Coffee, Registration, and Self-Assessment

9:05-9:15am Welcome

9:15-9:35am Updated Proposed FSMA Regulations

Deanna Baldwin, Maryland Department of Agriculture

9:35-10:00am FDA Current Authorities and Outbreaks

Deanna Baldwin, Maryland Department of Agriculture

10:00-10:30am Industry Perspective on the Importance of Food Safety

Bill Poole, Manager, Food Safety, Wegman's Food Markets

10:30- 10:45am Break

10:45-11:15am UME Water Quality Research and Mitigation Measures

Dave Martin, Univ. of Maryland Extension and Donna Pahl, Univ. of Maryland

11:15-12:00pm Demonstration of Accutab Water Chlorination System

Michael Leggett, Axiall Corporation

12:00-12:30pm Lunch

12:30- 1:15pm Water Sanitation Demonstration (including Peroxyacetic acid)

Christopher Walsh and Donna Pahl, Univ. of Maryland

1:15-2:00pm Equipment Cleaning and Sanitation

Donna Pahl, Univ. of Maryland

2:00-2:30pm "Experiences from the Auditor's Notebook"

Deanna Baldwin, Maryland Dept. of Agriculture

2:30-3:00pm Participant Discussion on GAP Audit Experiences

Dave Martin, Univ. of Maryland Extension

2:45-3:00pm Questions, Wrap-up, Adjourn



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Advanced Food Safety Training

50 Harry S. Truman Pkwy

Annapolis, MD 21401

April 8, 2016

9:00am to 3:30pm



9:00-9:15am Coffee, Registration, and Self-Assessment

9:15-9:30am Welcome and Introduction

Dave Martin, UMD Extension

9:30-10:00am Pathogens of concern: Salmonella and Listeria

Justine Beaulieu, UMD GAP Educator

10:00-10:45am FSMA Update

Sarah Everhart and Ashley Ellixson, UMD Extension

10:45-11:00am Break

11:00am-12:30pm Research presentations

Rohan Tikekar, UMD Assistant Professor

Manan Sharma, USDA Environmental Microbiologist

Chris Walsh, UMD Professor

12:30-1:00pm Lunch

1:00-1:30pm Resources available

Chris Walsh, UMD Professor and Justine Beaulieu, UMD GAP Educator

1:30-2:00pm "Experiences from the Auditor's Notebook"

Deanna Baldwin, Maryland Dept. of Agriculture

2:00-2:30pm Traceback and Recalls, Clean breaks

Deanna Baldwin, Maryland Dept. of Agriculture

2:30-3:15pm Panel Discussion on GAP Audit Experiences

Dave Martin, Univ. of Maryland Extension, Baltimore County

3:15-3:30pm Questions, Wrap-up, Adjourn



Good Handling Practices (GHPs): **Cleaning and Sanitation of Equipment and Packing Lines**

Donna Pahl, University of Maryland

Introduction

Good Handling Practices, or GHPs, refer to the practices that occur during or after produce harvest. These practices vary by farm and commodity, and may include harvesting (manually or mechanically), packing (in a field or going through a packing line), refrigeration, and transportation. These particular practices occur directly before the produce is sold to the consumer, and are therefore very important.

This fact sheet focuses on one large aspect of GHPs: cleaning and sanitation of equipment, packing lines, and harvest containers. Produce coming from the fields may have low, but measureable, levels of pathogens. Our goal with having a cleaning and sanitation program is to minimize the transfer of pathogens between batches of produce. By improving the cleaning and sanitation practices on equipment and produce contact surfaces, we can limit the introduction of pathogens from the packing area and minimize chances of cross-contamination.

Why is cleaning and sanitation of equipment and packing lines important?

Dirt and contamination on equipment, packing lines, and produce contact surfaces can introduce both human and plant pathogens (such as molds) to harvested produce. This type of contamination not only reduces the quality of the produce, but it shortens its shelf-life and storage ability as well. Bacteria on equipment can also form a build-up of biofilms – a hard plaque of bacteria that is very difficult to remove and can lead to microorganisms breaking off and re-contaminating produce.

What is sanitary design?

Sanitary design simply means that equipment and packing lines can be properly cleaned and inspected between uses. Packing areas are set up so that any equipment, tables, and other surfaces:

- 1) Can **be accessed for inspection**. Allow for room between equipment and walls, so that all parts of the packing line can be monitored for buildup of dirt and debris. Shields can be removed for further inspection.
- 2) Are **constructed** from materials that can be properly cleaned and sanitized.
Attributes of sanitary construction include:
 - a) having hard surfaces that are impervious and nonabsorbent,
 - b) easily cleanable,
 - c) smooth surfaces,

- d) resistant to wear and corrosion,
- e) can withstand action of cleaning and compounds,
- f) light colored (so that dirt and buildup can be easily spotted).

Materials such as wood, sponges, and foam are almost impossible to clean and sanitize, when compared to metal and stainless steel. If possible, cover wood and foam bumpers on packing equipment with vinyl or another material that can be cleaned. Wooden tables can also be covered with plastic or vinyl (even tablecloths), to increase ability to clean and sanitize.

- 3) Are **operated and maintained** in a way that minimizes contamination. This includes training workers on cleaning practices, performing those cleaning and sanitation practices regularly (on a scheduled basis), and performing regular inspections.
- 4) Have a **linear flow** through the packing area. Try to minimize the cross-over between incoming produce from the field, and packed produce ready to be shipped out. Additionally, keep culls and trash in separate areas. This linear flow keeps everything organized and prevents cross-contamination.

Diagram: Examples of an unorganized flow through the packing area from receiving to shipping (on left), versus a linear flow through the packing area (on right):

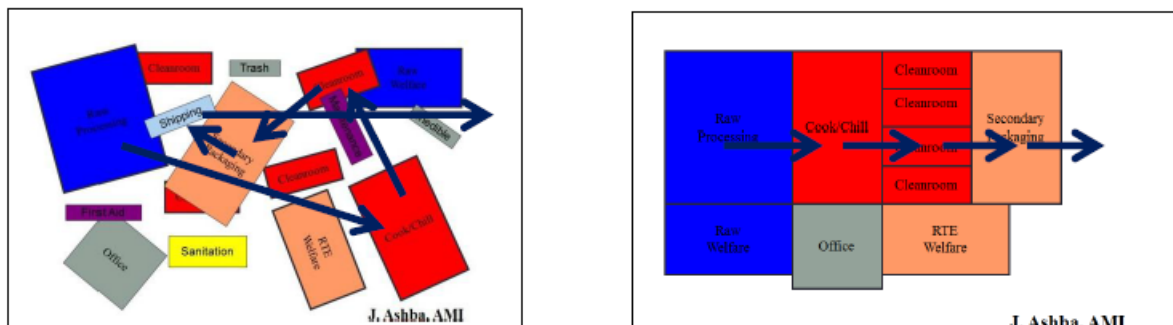


Figure source: J. Ashba, American Meat Institute.

What needs to be cleaned and sanitized?

There are several “control zones” within a packing area, which are dependent on how close the produce is to each zone. Spend more time focusing your cleaning and sanitation on the direct contact surfaces (Zone 1), however all areas of the packing area will need to be addressed.

Zone 1: The area in the packing house with direct **produce contact surfaces** (any area that touches the produce) after a microbial reduction step (such as a dump tank) and before packaging. If there is no kill step, Zone 1 is where the produce is exposed to the packing equipment until it is packed.

Examples of Zone 1: Conveyor belts, brushes, bumpers, tables, tubing, utensils (knives, cutting boards), ice makers and ice storage bins, gloves, aprons.

Zone 2: Non-product contact areas that are **adjacent to contact surfaces**.

Examples of Zone 2: Lubricants, equipment framework supports, drip shields over the produce, lights, water nozzles, equipment buttons, phones (workers will be checking their phones before touching produce), cleaning tools (brooms, mops, buckets, sponges).

Zone 3: Non-product contact areas **within the packing/processing area** that are removed from produce contact surfaces BUT could result in cross-contamination.

Examples of Zone 3: Floors, hoses, condensate, forklifts, trash cans, walls and ceilings, pallets, drains



Zone 4: Farthest from the **production area**. This zone includes all non-product contact surfaces outside of the packing area.

Examples of Zone 4: Cooler/freezer floors, bathrooms, breakrooms, loading docks.

Figure: Examples of control zones in a packinghouse.

Photo source:

<http://www.qvcustomsoftware.com.au/Images/CaseStudies/Turiwiri%20Packing%20Line.jpg>

What are the steps involved in cleaning and sanitizing a packing area?

1. **Remove dirt and debris.** Detergents and sanitizers will not be able to properly clean and kill microorganisms in a dirty environment. This may be done with a broom or rake to remove bulk debris, depending on how dirty the equipment is. A water rinse can then be used to soften and remove dirt.
2. **Use a surfactant solution**, like soap and water, to remove the rest of the dirt. There are many types of cleaners that can be used (surfactants, alkaline cleaners, acid cleaners, enzymatic cleaners) depending on the surface and type of soil you are dealing with (oils or animal fats, for example). Surfactants, the category that includes soaps and detergents, are suitable for most surfaces and soils and are easy to obtain. Surfactants work by lowering the surface tension of water which allows for increased penetration into the soil and for soil to be suspended in solution. Surfactants can also be successful in removing bacterial biofilms from equipment.

3. **Use a water rinse to remove surfactants and soil.** This rinse step will remove any soil and surfactants left on the equipment. Residual surfactants (soaps and/or detergents not rinsed off) would counteract the efficacy of the sanitizer about to be used.
4. **Apply a sanitizer to disinfect your equipment and packing area.** Sanitizers are relied on to kill disease-causing bacteria, viruses, and parasites on food-contact surfaces. Certain sanitizers are also effective in removing bacterial biofilms from equipment.

What sanitizer should I use for sanitizing my packing line and equipment?

Type of Sanitizer	Recommended Concentration	Advantages	Disadvantages	Examples
Chlorine	50 – 200 ppm	<ul style="list-style-type: none"> - Relatively inexpensive - Easy to obtain - Effective on wide range of bacteria 	<ul style="list-style-type: none"> - Dependent on pH - Breaks down with organic matter - Light degradation - Limited use on organic processes - Corrosive - Off-gassing at high temperatures 	<ul style="list-style-type: none"> - Chlorine bleach (Sodium hypochlorite) - Calcium hypochlorite
Peroxyacetic Acid (Peracetic acid, PAA)	50 – 350 ppm (Check manufacturer's label)	<ul style="list-style-type: none"> - Removes biofilms - Stable at range of pH levels - Not broken down by organic matter - Effective on wide range of bacteria 	<ul style="list-style-type: none"> - More expensive - Corrosive - Can be volatile at high temperatures 	<ul style="list-style-type: none"> - Tsunami (Ecolab) - Sanidate (Biosafe Systems)

What records must be kept for your cleaning and sanitation practices?

1. Material Safety Data Sheets (MSDS) and labels for any cleaners and sanitizers.
2. Logs of application time, date, and concentrations.
3. Standard Operating Procedures (SOPs). These should include enough information for any worker to perform the cleaning and sanitizing tasks. These SOPs can be very useful when training new workers how to perform these important cleaning and sanitation practices.

Key concepts to include in the SOPs include:

- Concentration of cleaners and sanitizers used.
- How is the required concentration of sanitizer measured?
- How is the concentration of sanitizer adjusted?
- How often are the levels of sanitizer monitored?

- Does water pH or temperature need to be monitored? If so, how often?
- What are corrective actions if the levels are insufficient?
- What is the required contact time for each cleaner and sanitizer?

Processing / Packing Line Log

Name of operation:

Please see the food safety plan for overall processing/packing line water control procedures.

Date	Cleaning List (check each)					Date Cleaned	Treatment	Cleaned By (name)
	Contact Surface	Dump Tanks	Flumes	Wash Tanks	Hydro Cooler			

Figure: Sample log for documenting cleaning and sanitation practices.

Log source: www.gaps.cornell.edu

How can cleaning and sanitation practices be verified?

Cleaning and sanitation practices can be verified through several means.

1. **Review documentation** to ensure that cleaning schedule is being adhered to, and that your packing area and equipment are being cleaned and sanitized regularly.
2. **Visually inspect** all surfaces regularly – especially those difficult to clean areas. These areas can be under safety shields, near packinghouse walls, or just difficult to reach. These are the areas that are most often neglected.
3. **Swab Zone 1 areas** (produce contact surfaces) for dirt and debris using wet sponges. If sponges become dirty while swabbing, then cleaning practices are insufficient. Additionally, sponge and swab samples can be taken and tested for pathogens. If pathogens are present, then cleaning and sanitizing measures must be improved.

Do food-grade lubricants need to be used?

Food-grade lubricants need to be used for any contact surfaces (Zone 1) – even if contact is unlikely. These surfaces include chain lubricants, gearbox fluids, hydraulic and compressor fluids, and general purpose lubricants. Non-food grade lubricants are acceptable for surfaces that do not contact food.

Cleaning and Sanitation of Harvest Containers

The above practices listed in “Cleaning and Sanitizing a Packing Area” can be used for cleaning and sanitizing harvest containers. Since these picking containers are often reused and left out in the field, it is recommended that cleaning and sanitization occurs on a scheduled basis.

We recommend the following steps when washing plastic harvest containers (see above “Cleaning and Sanitizing a Packing Area” for more detail):

1. **Remove dirt and debris.** As mentioned above, detergents and sanitizers will not be able to properly clean and kill microorganisms in a dirty environment. Any caked-on dirt can be scraped or brushed off.
2. **Use a surfactant solution,** like soap and water, to remove the rest of the dirt. If dirt is caked-on, let the container sit in solution for a few minutes. Dirt will loosen and be able to be scrubbed off. This step can be done in a large sink, wheelbarrow, or plastic container. If soapy solution is sprayed on containers (and not allowed much contact time), more scrubbing may be needed.
3. **Use a water rinse to remove surfactants and soil.** This rinse step will remove any soil and surfactants left on the containers. Residual surfactants (soaps and/or detergents not rinsed off) would counteract the efficacy of the sanitizer about to be used.
4. **Apply a sanitizer to disinfect your harvest containers.** Sanitizers are relied on to kill disease-causing bacteria, viruses, and parasites on food-contact surfaces. The easiest manner of disinfecting containers is to dip into a wheelbarrow, sink, or tub full of sanitizing solution. The same sanitizers can be used as mentioned above in the “What sanitizers can I use for sanitizing my packing line and equipment?” section.
5. **Allow containers to dry before being used.** Wet containers have a greater chance of enabling the cross-contamination of microorganisms, both human pathogens and plant pathogens.
6. **Fill out and sign off on harvest container cleaning log.**

Additional Resources:

1. “Calculating, measuring, and adding chlorine to water.” University of Maryland.
<https://www.youtube.com/watch?v=CAfKOREDQNI>
2. “Cleaning and sanitizing basics.” Pennsylvania State University.
<http://extension.psu.edu/food/dairy/cleaning-sanitizing-resources/cleaning-and-sanitizing-basics>
3. “Choosing and Using a Chlorine-based disinfectant during postharvest handling of fruits and vegetables.” North Carolina State University Extension Program.
<https://www.uvm.edu/~susagctr/whatwedo/producesafety/GAPsResources/gapresChlorineProductChoosing.pdf>

Sources:

1. “Facilities and Equipment Cleaning and Sanitation”. Improving the Safety and Quality of Fresh Fruits and Vegetables: A Training Manual for Trainers. Joint Institute for Food Safety and Applied Nutrition.
2. “Types of Cleaners”. Penn State Food Science Food Safety and Sanitation.



Good Handling Practices (GHPs):
Postharvest Water Use and Sanitation

Donna Pahl, University of Maryland

Introduction

Water is used in many aspects of fruit and vegetable production. **This factsheet will focus on the requirements of postharvest water use – water used during harvest, packing, cooling, and transportation.** Since this water is being used on fresh produce directly before going to the consumer, having high-quality water is very important in minimizing the contamination risk.

Depending on the manner in which water is used during harvest and packing, a water sanitizer may be required to minimize the risk of pathogens being transferred between batches of produce. Although water sanitizers do not disinfect (kill off) pathogens on the surface of the produce, they are very effective in killing off any pathogens (both human pathogens and plant pathogens, such as molds and bacterial rots) in the water. This prevents water from carrying microorganisms between batches of produce.

What are the quality requirements for the postharvest application of water?

Potable (drinkable) water is required for any water use after the crop has been harvested, since the product will be immediately going to the consumer without another sanitation step (such as cooking). In order to test the potability of a water source, labs will test for three things: the level of total coliform bacteria, turbidity, and level of nitrates. **Total coliform bacteria** are a type of environmental bacteria, which are also present in fecal waste. **Turbidity** is the measurement of cloudiness in the water – higher turbidity can be associated with higher levels of disease-causing microorganisms. Lastly, **nitrates** are an indicator of contamination in the water source, coming from fertilizer, leaking septic tanks, or erosion of natural deposits. High levels of nitrates can lead to illness, such as blue baby syndrome.

Potable water is also required for ice production, drinking water, hand washing, and to wash and sanitize harvest containers and equipment.

If a well is the water source for postharvest water use, then it is recommended that the water source be tested at least once annually.

Water testing criteria

Test result limit

Total Coliform Bacteria	Absent or 0 MPN or CFU/100 ml
E. coli	Absent or 0 MPN of CFU/100 ml
Turbidity	<10 NTU*
Nitrates	<10 mg/L

* NTU = Nephelometric Turbidity Units

Where can I get my water sampled?

Many water testing laboratories will be able to run the water potability tests mentioned above. If you are looking for a water testing lab that can run tests on postharvest water sources as well as irrigation water sources, a list of Maryland laboratories can be found at the Maryland Department of Agriculture's Good Agricultural Practices (GAPs) website at: <http://mda.maryland.gov/foodfeedquality/Documents/GAPWATERTESTINGLABS.pdf>

If the water source used for postharvest practices is already tested by the Maryland Department of Health and Mental Hygiene (for example, if the same source is used in a commercial kitchen), the testing records can often be pulled and used from DHMH.

When is postharvest water required to be treated with a sanitizer?

Postharvest water usage can be broken down into two major categories. **Batch use (reused) water** should be treated with a sanitizer before and during use, since the water will be contacting multiple loads of produce.

- 1) **Single-use water:** Water is only passed over produce once, and is not reused. An example of this would be spraying fruits or vegetables with a hose, faucet, or sprinklers to wash or cool them down. After passing through the produce, the water drains off and is not used on another batch. Since the water is used on only one set of produce, risk of cross-contamination is minimal.
- 2) **Batch-use water, or reused water:** Water is reused between loads (or sets) of produce. An example of batch water would be water in a dump tank, wheelbarrow, three-section sink or recirculating system. After one load of produce is removed, another is placed in without changing the water. If the water were to become contaminated, it can easily spread pathogens to other batches of produce. Treating reused water with sanitizer lowers the risk of cross-contamination by killing microorganisms present in the water.

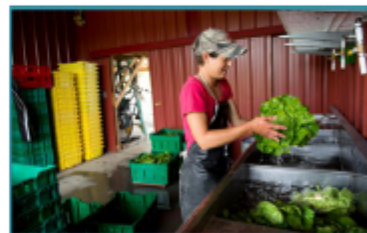


Photo: Examples of single-use water from a hose and mesh table (above) and reused water in a three-section sink (below).

*Source: baybranchfarm.com,
carolinafarmstewards.com*

What sanitizers do you recommend for treating postharvest water?

Type of Sanitizer	Recommended Concentration	Advantages	Disadvantages	Examples of Sanitizers Labeled for Produce Washing
Chlorine	50 – 150 ppm (Check manufacturer's label)	<ul style="list-style-type: none"> - Relatively inexpensive - Effective on wide range of bacteria 	<ul style="list-style-type: none"> - Dependent on pH - Breaks down with organic matter - Light degradation - Limited use on organic processes - Corrosive - Off-gassing at high temperatures 	Sodium hypochlorite: <ul style="list-style-type: none"> - Agclor-310 (kellysolutions.com) - Freshgard 72 (kellysolutions.com) - Dixichlor (lyndist.com) - Pac-chlor (paceint.com) Calcium hypochlorite: <ul style="list-style-type: none"> - Accutab (accu-tab.com)
Peroxyacetic Acid (Peracetic acid, PAA)	30 – 80 ppm PAA (Check manufacturer's label)	<ul style="list-style-type: none"> - Removes biofilms - Stable at range of pH levels - Not broken down by organic matter - Effective on wide range of bacteria 	<ul style="list-style-type: none"> - More expensive - Corrosive - Can be volatile at high temperatures 	<ul style="list-style-type: none"> - Tsunami (Ecolab) - Sanidate (Biosafe Systems)
Ozone	See manufacturer's instructions	<ul style="list-style-type: none"> - Quick kill rates - Generated on-site - No residues 	<ul style="list-style-type: none"> - Expensive start-up costs (purchase ozone generator) - Can pose inhalation health risk - Low residual effect 	

Note: Any sanitizers that contact fruits and vegetables must be food grade and registered for fruit and vegetable washing. Household bleach does not have an agricultural use label, and cannot be used as a water sanitizer.



A solution of Sodium Hypochlorite for control of organisms causing decay of apples, asparagus, cabbage, carrots, cauliflower, celery, cherries, citrus, cucumbers, lettuce, mushrooms, nectarines, onions, peaches, pears, peppers, potatoes, prunes, quinces, and radishes after harvest.

Figure: Sample agricultural label for Agclor 310, a sodium hypochlorite sanitizer.

Source: www.kellysolutions.com

What are the recommended practices for treating water with chlorine?

1. The chlorine-treated water should have a pH between 6.5 and 7.0. The effectiveness of chlorine depends heavily on the pH of the water: if the pH is too high (basic), the chlorine will not be available in a form to kill microorganisms. If the pH is too low (acidic), too much chlorine will be available and can become corrosive.
 - Test the pH of your water after it has been treated with a sanitizer and thoroughly mixed.
 - If the pH is above 7.0, use a food-grade acid to lower the pH of the water (examples include: citric acid, muriatic acid, phosphoric acid).
 - If the pH is below 6.5 (less likely scenario), use a food-grade base to increase the pH of the water (examples include: lye, bleach).
2. Maintain free chlorine levels between 100 to 150 parts per million (ppm). Test strips can be purchased that measure free chlorine levels (do not purchase strips that measure total chlorine, these numbers are not important for our use). Be sure to purchase strips that measure high ppm of free chlorine (up to 120 ppm) – some strips sold at pool stores only measure 1 to 5 ppm.
 - Instead of using paper strips, electronic meters that measure the oxidative reduction potential (ORP) can also be purchased to measure levels of free chlorine.
3. Check free chlorine and pH levels frequently and regularly.
4. Prevent leaves and organic matter (such as leaves and soil) from entering dump tanks and reused water. If necessary, try to brush off soil from produce surfaces before placing in dump tanks. Organic matter will quickly bind to and eat up chlorine in water.
5. Drain and clean dump tanks regularly. When cleaning tanks with surfactants (soap) and water, be sure to completely rinse off soap before adding sanitizer.

If I decide to use chlorine as a sanitizer, how much should I add to my water?

If your chlorine label gives instructions on amounts to use, **follow the labeled instructions.**

Two other options for measuring chlorine sanitizer include:

1. For a **quick guide** to the amounts of chlorine bleach to treat 100 gallons of water, below is a table using two common concentrations of chlorine bleach: 5.25% and 12.75%.

Table: Mixing solutions using common chlorine bleach concentrations.

Desired ppm of Free Chlorine	Pints of 5.25% NaOCl Solutions per 100 gal. of water	Pints of 12.75% NaOCl solution per 100 gal. of water
50	0.8	0.3
75	1.1	0.5
100	1.5	0.6
125	1.9	0.8
150	2.3	0.9
175	2.7	1.1
200	3.0	1.3

Source: "Chlorine Use in Produce Packing Lines". University of Florida.

2. To prepare a **specific solution using a particular concentration** of sodium hypochlorite (NaOCl), the following formula can be used.

$$\text{Volume of NaOCl to add} = \frac{(\text{Desired ppm of free chlorine}) \times (\text{Total Tank Volume})}{(\% \text{ NaOCl in concentrate}) \times (10,000)}$$

Example: We will calculate the amount of sodium hypochlorite (bleach) to add to a:

- 1,000 gallon dump tank
- We want a 150 ppm free chlorine concentration
- We have a 12.75% sodium hypochlorite solution (found on the label)

$$\text{Volume of NaOCl to add} = \frac{150 \text{ ppm} \times 1,000 \text{ gallons}}{12.75\% \times 10,000} = 1.18 \text{ gallons sodium hypochlorite}$$

What documentation is required when using water sanitizers?

1. Include **annual water test results** for the water source.
2. **Material Safety Data Sheets (MSDS) and labels** for all chemicals used in water sanitation (including sanitizers and any chemicals adjust water pH).
3. **Logs** of application time, date, and concentrations.

Name of operation:

Please see the food safety plan for overall water treatment procedures.

[illegible]

Reviewed by

TEMP

DATE _____

Log source: www.gaps.cornell.edu

- Key concepts to include in the SOPs include:

- Do any practices need to be used for monitoring the quality of ice?**

Any ice makers, holding tanks, or other equipment (such as scoops and shovels) that come in contact with ice will need to be cleaned and sanitized regularly.

Additional Resources:

1. "Choosing and Using a Chlorine-based disinfectant during postharvest handling of fruits and vegetables." North Carolina State University Extension Program.
<https://www.uvm.edu/~susagctr/whatwedo/producesafety/GAPsResources/gapresChlorineProductChoosing.pdf>
2. "Chlorine use in produce packing lines." University of Florida.
<https://edis.ifas.ufl.edu/ch160>
3. "Calculating, measuring, and adding chlorine to water." University of Maryland.
<https://www.youtube.com/watch?v=CAfKOREDQNI>
4. "Water testing labs for GAP". Maryland Department of Agriculture.
<http://mda.maryland.gov/foodfeedquality/Documents/GAPWATERTESTINGLABS.pdf>



Larry Hogan, Governor
Boyd Rutherford, Lt. Governor
Joseph Bartenfelder, Secretary
James P. Eichhoeft, Deputy Secretary

The Wayne A. Cawley, Jr. Building
50 Harry S. Truman Parkway
Annapolis, Maryland 21401
Internet: www.mda.maryland.gov

410.841.5700 Baltimore/Washington
301.261.8106 Washington, D.C.
800.492.5590 Toll Free

FOOD QUALITY ASSURANCE PROGRAM
(410) 841-5769 FAX (410) 841-2750
Produce Good Handling Practices Program

1. Produce must be received in clean transport vehicles and containers. Produce that arrives in vehicles and/or containers that also contain potentially contaminating products (meat, poultry, chemicals, filth, fertilizer, etc.) cannot be accepted. Produce with significant decay cannot be accepted. Refrigerated commodities must be monitored for temperatures at time of receiving. A plan for disposal of product not meeting the standards must be part of the food safety plan.
2. The facility must be clean and maintained in an orderly manner.
3. Refrigeration units including condensers, fans, etc. must be maintained in a sanitary manner and condensation cannot come in contact with produce. Iced product cannot drip on produce stored below.
4. An annual water test must be conducted to ensure all water (including water used to make ice) that contacts produce is potable.
5. A disposition plan for produce that comes into contact with the floor or other unsanitary areas must be included in the food safety plan.
6. All product flow zones must be protected from sources of contamination.
7. Glass materials above product flow zones must be contained to prevent contamination of product in the event of breakage.
8. The grounds must be maintained free of litter, debris, standing water, or other materials that can harbor/attract pests.
9. Outside garbage receptacles/dumpsters must be closed and located away from the facility and the area around these sites must be kept clean.
10. The facility where produce is packed and/or stored must be enclosed.
11. Floor drains must be free of obstructions.
12. Pipes, ducts, fans, ceilings must be kept clean.
13. Sufficient distance, barriers, or drains must be maintained between wastewater disposal and food storage or handling areas to prevent contamination of the produce.
14. Non-food grade substances cannot be stored in close proximity to the produce.
15. An established pest control program must be in place and measures to exclude animals or other pests from the facility must be taken. Documentation of compliance with the pest control program must be maintained.
16. Interior walls, floors and ceiling must be well maintained and free of major crack and crevices.
17. Repacking/reconditioning processes must be confined to an established location in the facility that is regularly cleaned and maintained. Storage areas must be well maintained and cleaned and sanitized on a regular basis.
18. Food contact surfaces must be well maintained and cleaned and sanitized prior to use. Documentation of cleaning and sanitizing must be maintained.
19. Containers and pallets must be clean and in good condition. Packing containers must be stored and protected from contamination.
20. Employee facilities (locker rooms, lunch and break areas, etc.) must be separate from areas where produce is packed and/or store.

FINAL REPORT

Project Title: Assessing the Invasiveness of Plants under Consideration for Regulation in Maryland

PROJECT SUMMARY:

In 2011, the Maryland General Assembly passed landmark legislation (Md. AGRICULTURE Code Ann. § 9.5-101 et. seq.) requiring the establishment of an Invasive Plant Advisory Committee (IPAC) to advise the Secretary of Agriculture in adopting regulations that 1) establish a science-based risk assessment protocol for invasive plants that will serve as a basis for creating a two-tiered regulatory approach for controlling invasive plants in the State and that considers the harm that invasive plants cause in the State, including economic harm, ecological harm, environmental harm, and harm to human health and 2) to establish a list of Tier 1 plants, which are banned from sale, and a list of Tier 2 plants, which require labeling at the retail sale level and notification with landscape sales installations regarding their invasiveness, in accordance with the risk assessment protocol.

The objective of this project was to conduct and disseminate Weed Risk Assessments (WRA) to provide Maryland regulators with a scientifically determined basis for establishing regulated species lists. The project uses a United States Department of Agriculture (USDA), Animal and Plant Health Inspection Services (APHIS) WRA protocol that not only identifies which plant species are likely to become invasive, but also summarizes a large amount of information about the species in an easy to interpret, user friendly document format. The WRA products also inform the establishment of regulated invasive plant lists in Maryland, and provide outreach and education to increase public understanding, acceptance, and support of pest plant control efforts and will facilitate positive changes in the nursery and landscape industries.

PROJECT APPROACH:

During the initial grant period, the MD IPAC made a list of 32 species with priority for assessment. Within this list the species were further prioritized based on availability of information about the species. Two additional species were added that are currently not sold or are not present in large numbers within the state to further test the protocols developed.

University of Maryland hired three part-time research associates to complete assessments in August, 2014 under the guidance of Dr. Maile Neel. These researchers traveled to the USDA APHIS Risk Analysis Lab in Raleigh, NC for a three day training workshop on using the APHIS Weed Risk Assessment protocols in October, 2014.

Assessments have been completed and are now in regulation for 6 species. An additional 4 species were submitted for regulation and those regulations should be published in December. Two other species assessments have been completed and reviewed by IPAC and are ready to

submit for regulation. Another 10 species WRAs are mostly completed but have not had the GIS analysis completed for them.

All of the partners made significant contributions to this project. University of Maryland provided researchers and access to library and herbarium resources. IPAC provided a list of initial plants for assessment. One species were added to this list because it could potentially be sold in Maryland but was not currently naturalized in the state. A second species was added because it is occasionally sold in the nursery trade but is not yet widespread in natural areas. IPAC reviewed completed WRAs and provided timely feedback. MDA provided meeting space for IPAC and participates on IPAC. MDA handled submitting species for regulation and manages the web site for the invasive plant law where the WRAs are posted.

GOALS AND OUTCOMES ACHIEVED:

The weed risk assessments require research on many aspects of a plant's biology as well as its impacts on natural, agricultural and anthropogenic systems. We completed this research for 22 species. Additionally a geographic analysis provides information on the potential range of the species. This analysis was completed for 12 species. The original goal was to complete 30 weed risk assessments.

The WRAs for 10 species have been posted to the MDA web site. Two additional species are ready to be posted. The goal was to post 30 weed risk assessments.

BENEFICIARIES:

The Nursery and landscape industries will benefit from this project. Consumers will also benefit by learning about invasive plant risk and being able to make informed choices in their garden and landscape plantings.

Although many nurseries have attempted to “do the right thing” and promote non- invasive choices to their customers, the efforts have been voluntary and undermined by nurseries where invasive plant choices are available. Additionally, other states’ invasive plant laws have impacted out-of-state markets for horticultural plants. The Maryland law promotes consistency and predictability in markets and planning. In the *2011 Final MaGIC Legislative Update* (attached), the Maryland Green Industries Council (MaGIC) indicated its support for *Maryland House Bill 831: Agriculture - Invasive Plants - Prevention and Control*, the basis for this grant activity. This IPAC is, per statute, is composed of a diverse group of stakeholders, including one individual from a landscaping industry that is regulated by the Department, and one individual from a plant wholesale industry or a plant retail industry that is regulated by the Department. The Maryland Nursery and Landscape Association (MNLA) appointed both members, who are involved in all decisions, and provide feedback from MNLA regarding concerns and needs of the nursery and landscape industries.

A level playing field for industry will foster simplified intra- and interstate phytosanitary

shipping requirements, reducing costs for the vibrant northeastern nursery industry. According to the 2007 *Maryland Horticulture Industry Statistical and Economic Profile*, gross receipts of horticultural products and services in Maryland exceeded \$1.96 billion in 2007 and were expected to exceed \$2.05 billion in 2008. Approximately 20-25 % of plant material shipped was to out-of-state customers.

LESSONS LEARNED:

The Weed Risk Assessment protocols chosen by IPAC are very thorough and should answer any questions the nursery industry or the public has about whether a species poses a high risk of invasion or not. The protocols also elucidate the current impact particular species are having on Maryland's natural, agricultural, and anthropogenic system. IPAC underestimated the amount of time that the research and GIS analysis would take per species risk assessment. Only one of the three research associates was trained to do the GIS analysis and has access to GIS software, which significantly slows down the ability to complete assessment. Since this project took more time than expected and the project would not be complete by the deadline, there was a request to amend the budget scope.

IPAC spent considerable time deciding on what to do about cultivars that the nursery industry considers non-invasive. It developed a protocol for determining whether these cultivars do pose a risk of invasion or whether they can be excepted if the species is regulated. The hope is that this protocol will encourage the development of truly non-invasive cultivars of popular landscaping plants.

Contact Person:

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410-841-5920
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Additional Resources:

[MDA Invasive Plants Prevention and Control web site](#)

FINAL REPORT

Project Title: ECO City Farms Microgreens Project

1. PROJECT SUMMARY

ECO City Farms' goals of this project were to develop an effective and successful microgreens growing operation on a small scale that would supplement current crops grown at the farm, developing systems, setup, processes and strategies which would be replicable and transferrable for other small farmers to create supplemental farming income, and to transfer this system and lessons learned to interested individuals through trainings and written guidelines. We wanted to demonstrate the ability for small and urban farms like ECO to take advantage of the economic opportunity grow microgreens for the nearby restaurant and wholesaler market.

Over the two year grant period, ECO evaluated its growing space, tested varieties of microgreens and shoots, developed a growing and harvesting systems and schedule, recruited a wholesale customer, developed financial mechanisms, held a microgreens growing training, and wrote growing operation guidelines. By the end of the project, ECO had a successful microgreens growing operation that was highly transferrable to any small farming operation in rural or urban areas and developed and implemented tools for sharing its operation.

2. PROJECT APPROACH

Work for this project was planned and executed in accordance with the five distinct goals outlined in our project work plan:

- 1) **Production:** Develop standard practices for urban and small farm microgreens growing operation
- 2) **Logistics:** Develop logistics system from harvest to delivery
- 3) **Financials:** Identify, outline and document the financial planning, tracking and management elements needed to launch and sustain microgreens growing operation
- 4) **Report:** Create a full "How-To" report including lessons learned and all the documented guidelines listed in above goals for free distribution to area farmers
- 5) **Education:** Actively educate area farmers and sustainable food professionals about the value, care and nurturing of a viable microgreens growing operation, complete with lessons learned and guidelines created.

The following narrative outlines our activities and tasks performed during the entire grant period. Detail on performance measures will follow in section 3.

Project Activity Timeframe:

November 2013 - April 2014: Field Research and Initial Trials

Research: Before we began our operation, we knew that we needed to research the best microgreens practices as much as possible. Staff developed a list of interview questions for other microgreen growers in the country, covering topics including seed (seed sources and seed to yield ratios), growing media, germination conditions (density of seed, length kept in dark, infrastructure), growing conditions (how much light, infrastructure, space, airflow, fertilizing), cold-weather considerations (cold-hardy crop varieties, lighting, heating), harvesting techniques (equipment, processing, post-processing) and packaging, marketing and pricing.

Staff reached out to four other microgreen growers, and successfully interviewed three. In addition, researched microgreen growing techniques online, from various agricultural resources and seed companies including Johnny's Seed Company and High Mowing Seed Company.

Lessons Learned: The main lessons learned through these interviews was that each grower had a different method, grew different crop varieties, and their packaging type depended on who is purchasing their product. We learned that the biggest issue they faced consistently was fungus; and that compost was the best fertilizer and that seeds were the greatest cost of the operation. For us, however the greatest lesson learned was to trial as much as possible because each site is different, much like farming.

Trials Begin: As is the case with all farming, we knew we had to take good notes and so developed a chart where we could track our trials. By documenting the pertinent information for each trial we were better able to track the successes and failures and troubleshoot to minimize the latter. (See samples of forms used at end of document.) In our first Microgreen Log, we included on a sheet for each crop: the date it was seeded, media used, tray size (flat, 50, 72, 128), whether we used heat or no heat, quantity of trays, quantity of seed per tray, harvest yield and harvest date.

From the interviews and research we conducted, we compiled a list of 20+ crop varieties of microgreens using several different types of media. Those trials consist of: Kogane Chinese Cabbage, Red Cabbage, Persian Cress, Cressida Cress, Red Top Beet, Yellow Beet, Cilantro, Red Giant Mustard, Ruby Streak Mustard, Suehling Mustard, Ruby Red Chard, Red Choi, Red Komatsuna, Komatsuna OP, Arugula, Rambo Radish, Purple Kohlrabi, Broccoli Sprouts, Sunflower shoots and Pea shoots. We used several different media in our first trials, mainly coconut coir, but sprinkled with vermicompost, soil amendments used on farm (green sand, kelp, azomite and alfalfa), or on-site produced potting mix (coir, windrow compost, vermicompost, kelp, alfalfa, azomite, greensand and endomichorrhizae).

We began seed variety trials in February 2014 when it was still cold, and so used a temporary smaller make-shift heated greenhouse and compared the results with those located in the larger unheated hoophouse (our hoophouses use passive solar heating).

Seeding Methods: Our method of seeding began with flattening the media with the underside of a 10x20 tray. Then we sprinkled the seeds on top going by tablespoons to measure quantity of seed. We left some seed bare, watered them and covered with 10x20 trays flipped underside-up.

We also tried sprinkling compost and amendment over top before watering and placing trays on top. The trays allowed adequate space for the shoots to sprout from their seed. Once the shoots reached the underside of the lid, we knew the lids were ready to be pulled off.

In the first three months of growing microgreens, we used mainly coir as the media, some with about a ¼ cup vermicompost or amendment mixed with the coir. We varied the quantity of seed per 10x20 tray, some with 50 cells, some 72 cells, and used between 1T to 2T per tray. The trays seeded w crops from the brassica family germinated in approximately 2 weeks and were ready to harvest by the third week. In the beginning we recorded yield using cups, rather than weight, to get a visual sense of what we were working with. We found a greater percentage of arugula and mustards germinated than the other varieties, with higher yields if vermicompost or amendment were incorporated into the coir. While we were getting approximately 75% of the seeds to germinate, we didn't feel the yield was great enough to justify the cost of seed. This is attributed to the size of the microgreens. The arugula and mustard greens, even when the tray was full, we found were very small and delicate - not very easy to harvest or process and would require a lot of trays to make a substantial weight.

The exception of Pea shoots should be noted here. Pea shoots were a microgreen we had worked with before and felt they continued to do best in flats using coconut coir as the single medium. We created a system of soaking 12 cups of Pea shoots in water for 24 hours then draining them and seeded 2 cups per 10x20 flat bedded with about an inch of coconut coir. We were able to get 15-16 flats seeded. It took approximately 12-14 days from seeding date to harvest and we would yield about 5lbs of shoots. It is also important to note that these production notes began in March. In February we had a difficult time with fungus. With the cold temperatures and short daylight hours, the peas would sit in damp coir for too long before actively growing.

Challenges: We did find that beginning with so many variables was challenging. It was difficult to keep track of every detail of each variety, especially since we did not yet have adequate space. We found we could only do one tray for each variety preventing us from gathering solid data. Crowding within the hoophouse occurred, impacting airflow to the microgreens while creating small microclimates that resulted in some flats drying out while others developed fungal issues from too much moisture. These microclimates are created by the angle of the sun and its duration of contact throughout the day.

May 2014 - November 2014: Production Testing Continues

Evaluating Process and Changes: With warmer months, we were able to clear more space inside the hoophouse allowing for better ventilation for our microgreens, though we still experienced inconsistencies in yield per flat. At best, with using one tablespoon of seed in coir mixed with amendment, we would yield .9oz of kohlrabi microgreens. There were other hang ups, as well. With having them all seeded in individual flats with lids, it was time consuming to check each flat to determine whether they needed to be watered. It was also difficult to determine whether they needed water by looking at the dampness of the coir as we didn't want to grow fungus but we wanted the seeds to have adequate moisture.

We realized that something in our method had to change. Other than Pea shoots that continued to

produce fairly well until temperatures rose into the 90s consistently, we weren't getting enough yield to supplement our regular farm share customer bags, let alone sell commercially.

In October, we began growing Pea shoots again which grow better in cool temps. We conducted more research and brainstormed ideas to improve yield with our other microgreens. We did more research into growing media and considered using soil instead of coir.

December 2014 - May 2015: Planning and Building Systems

Microgreen Nursery Build Out: In these months we built out the 96' x 26' hoophouse microgreens nursery by installing four 6' x 33" rolling nursery tables plus two 5' x 70 stationary tables to improve the efficiency of our hoop house space for both our seedlings and our microgreens. (See photo #). This included wooden frames for the microgreens beds. This was done using funds from another grant. We also developed plans for heating the rolling tables for microgreens to produce year round, and using the outer stationary tables for our seedlings. We also began to consider skipping using the flats all together and building up the tables so they appeared like salad tables and could hold soil, as though they were raised beds on rolling tables.

We installed a temporary electric heating mat under a layer of insulation on which we placed the microgreen flats. This functioned as a pilot temporary fix before we would receive our more efficient large scale heating mats that would require a hot-water heating system to run warm glycol through tubes that are located underneath the soil of the microgreen beds. We built out the bed structure with a low tunnel with plastic, roll-up bars and end walls to keep the daytime and nighttime temperatures more consistent. (see photos).

Finalizing Growing Media: We began to trial importing soil from our other growing beds to use in the microgreens flats. We used the make-shift heated greenhouse and found a more consistent yield per flat. In February we seeded 1 tablespoon of radish and yielded 6.4oz in 19 days (compared to the .9 oz of kohlrabi - member of the same crop family - this was an astronomical jump) and with ¾ tablespoon of cress, we yielded 4oz. in 19 days. At this time, we also seeded 1 tablespoon of radish using our potting mix as the medium and only yielded 2.2 oz in 20 days. This was evidence enough for us to continue with soil as our medium.

When outdoor temperatures began to increase with spring, we experimented microgreen production in our beds in the hoophouses and in cold frames bedded with soil. We continued to have much greater success than we had in the coir trays with better germination, yields, and could even cut and then have a second cutting from re-growth. For example, at the end of April, we seeded 3 tablespoons of arugula in a 20x40" space in a cold frame bedded with soil and 8 days later yielded 28oz. With more sunlight our days to maturity (from seed to harvest) decreased from 19 days to 8 days and reinforced the seasonality fluctuations we had learned from the previous year.

From here we concluded that soil was our best medium and so we started creating soil for our microgreens to use in flats that we placed on the rolling table beds. We began with native soil (previously tested to ensure it was safe) and mixed with compost. After each harvest, we dumped the debris in our 'microgreen compost pile' to decompose, putting nutrients back into the soil, much like we do in our beds in the hoop houses.

Data Sheets Modification: We also found that our data collection sheets weren't exactly working for us. Originally, we had a sheet for each crop with the aforementioned topics, but because our results vary so much from season to season, we found we'd rather like to read notes from season to season rather than from crop to crop. That way we could determine which crops to plant from season to season. We adapted our note-keeping once again to follow that of our workplan and found this to help us think clearly about what we're doing and to better document what we did and where we should go. We reduced the number of varieties and focused mainly on radish, kohlrabi, broccoli, sunflower, cress, and arugula. We chose those varieties due to their ease of germination, as well as nutritional quality.

Growing Bed System Finalized: By May 2015, we had discarded the idea of growing in flats and started to spread the soil on the rolling tables in built in frames. That saved us time on filling flats with soil, emptying the flats, and letting them compost. With about 4" of soil, we could then seed, harvest, and turn under the leftover debris before re-seeding again. At this time, we also perfected our growing bed construction. The bed area was developed into a 'sandwich' of items from our lessons learned in growing and construction trials and it consisted now of: constructed bed box, landscape fabric, insulation, heat mat, landscape fabric, then soil.

As time went on we reduced our varieties again to radish, buckwheat, and sunflower. The shoots are grown as leafy microgreens only. This was due to increasing temperatures (we had a very warm month of May), the ease of harvest, and the hardiness of the crop. As was mentioned earlier, some of the brassica microgreens were very fine and delicate making it difficult to process. The radish, buckwheat, and sunflower microgreens had thicker stems and leaves making it easier to harvest and process, not to mention yield a greater weight.

Local Buyer Confirmed: By the end of May we met with a produce buyer from the local restaurant chain store which is dedicated to buying local produce for its menu and supporting local food systems. The store was the ideal partner to start with for our first commercial sales. The store had expressed interest in the past in purchasing ECO's microgreens and we were finally ready and able to deliver our product on a steady reliable scale that they needed. After some discussion, the store determined that they would use ECO's microgreens for a seasonal specialty menu item, that would run from July to September in their restaurants and that ECO could provide the amounts they needed weekly.

Requirements of Distributor: The store worked exclusively with a distributor to coordinate their local produce purchasing and delivery. We would need to work with them to get our produce to the store. At first, we did not envision working with a distributor but it ended up being a great development for our microgreens operation. Going through the process of becoming a produce provider in their system helped us get up to speed and professionalizing our produce packaging. After an initial application, we met with the distributor's food safety staff, who inspected our operation on the farm and provided requirements that they would need for packaging and expectations for food storage and safety, such as tracking systems and tamper evident packaging, as well as suggestions on how to package for the best result in long lasting of the product, which we had not yet considered. Their needs shaped our packaging system and helped us get up to speed quickly on standards.

June 2015 - August 2015: Commercial Production and Sales Begins

Our contract with a store and distributor began in July and was to go to mid-September to accommodate a seasonal menu item that would use our microgreens. We decided to continue working with Radish microgreens as Buckwheat and Sunflower shoots would take a little over a week and Radish microgreens would produce within 5 days at this time of year. The buckwheat shoots are as leafy microgreens only. We found that 4lbs of China Rose Radish Microgreens seed would yield 15lbs of microgreens.

Packaging Requirements: The store required 30 8 ounce bags of microgreens weekly to distribute to each of their 30 stores in the DC metro area. After meeting with the distributor, we learned which packaging and information would be needed for each pick-up. We researched micro-perforated bag options and a heat sealing systems suggested by the rep and found inexpensive options that we began to use weekly. We created simple labels that included our required information, including harvest date and lot number. The distributor suggested using plastic clamshell containers, but we resisted because they are not recyclable and add to the waste stream.

Financial Management: We also finalized our financial tracking forms for the sales, creating sales receipts and logging lots for product tracing capability.

Throughout the summer, we had developed a system that was as consistent as farming could get. We seeded on Wednesday, watered morning and night leaving lids on until Saturday or Sunday morning when the shoots just about reached the top of the lid. We removed the lids allowing sunlight to activate the chlorophyll and fill in the plant and its first true leaves. By Monday or Tuesday, they were ready for harvest. They would all be processed, packaged and ready for pick-up the following day.

Processing System: We found that a quick harvest was extremely important: we needed to get greens to the sinks as soon as possible after harvest to prevent wilting. We developed a two-sink processing system. The harvest would go into one sink for an initial rinse and then moved to the second sink to remove any additional seed debris. It would then be spun in our salad spinner and placed on new paper towels in front on a fan to finish drying. The microgreens need to be dried thoroughly so they aren't damp and soggy in their produce bags. If they are still damp, it reduced the shelf-life of the produce.

September 2015 - November 2015: Economic Stability and Education

By mid-September, our agreement for microgreens sales with the store ended. Their seasonal menu item that used our microgreens, gazpacho soup, ended and they were not in the position to buy more of our microgreens over the fall/winter season. We felt our relationship with both the store and their distributor as very fruitful. We solicited feedback from the store throughout the summer on quality of our produce and found they were very satisfied, and expressed some interest in buying other types of produce from ECO during the winter season. We feel the information learned about what these produce distributors need is key to helping other microgreen growers succeed. We have included this information in the Growing Guidelines document we produced.

We approached a distributor to continue purchasing microgreens from ECO, offering different sized packaging if needed. They agreed to continue purchasing from us at the same price and package size, however, they wanted to have more color mixed in the microgreens, to sell as 'rainbow microgreens.' It took us about a month to trial new crops and varieties, not to mention adjust to the change in season. We felt that the commercial sales period with the store definitely paved the way for our relationship with the distributor. We recommend that other growers develop this type of relationship to get their business started, this is noted in the Growing Guidelines. Please see this extensive instructional document we developed for other growers to share the lessons we have learned.

Mitigating Seasonal Fluctuation in Operation: During the summer, there is plenty of sunlight and while it is hot, we installed fans to encourage airflow through our microgreen tables. In the fall, however, the weather becomes much less predictable. The sunlight hours decrease, the temperatures fluctuate and we have many more cloudy, damp days. If we have a week of nice days with plenty of sun, the seeds will germinate and complete their cycle before harvest within a week. If we have a week of cloudy weather and cooler temperatures, it can add about 3 or 4 days to the cycle. To mitigate the changing climatic conditions, we expanded our growing bed area and began to seed in two successions two days per week to ensure there was enough microgreens for orders.

The final component to be installed before this winter are heating mats and hot-water system to warm the beds during the coldest months. Based on last winter's trials with the electric heat mat, we predict with the heating system installation our production capability will increase. Our total current production is based on having demand for the microgreens product. At this time, we are growing enough to meet the demand of our primary customer, but will be easily able to expand as other customers are brought on board.

Recruiting Other Buyers: In October 2015, we also contacted another local distributor who expressed initial interest in carrying our microgreens. We were interested in expanding our production and were looking for additional buyers. This distributor is far larger and carry more varieties of microgreens. At time of writing, we have completed initial applications and are waiting on follow up from food safety staff for a farm inspection, as part of the acceptance process. We feel the information learned about what these produce distributors need is key to helping other microgreen growers succeed. We have included this information in the Growing Guidelines document we produced.

Microgreens Growing Educational Session: On October 17 we held a free two hour microgreens growing workshop to share our operation. This was led by ECO's farmer, the microgreen intern, and another local microgreens producer from Little Wild Things. Topics included space requirements, using flats versus beds, natural or artificial light, varieties of microgreens, harvesting and processing techniques, marketing to restaurants and farmers markets, fungus and pests, and distribution. There were ten attendees which included other growers and beginning farmers. Additionally, we will be looking to present results of the microgreens operation at area farming conferences during the winter.

Microgreens Growing Guidelines: By early November and the conclusion of the grant period, Growing Guidelines were completed and are available for future presentations, workshops and inquiries about our operation. The Growing Guidelines are attached as a separate document that we developed for other growers. Please see this extensive instructional document we developed for other growers to share the lessons we have learned.

3. GOALS AND OUTCOMES ACHIEVED

(reflect expected measurable outcomes in application)

Project Results at end of two year period

The following results and systems that were researched, tested and selected are documented in the Guidelines for Growing document for other farmers.

<i>Goal 1. Production: Develop protocols and standard practices for urban and small farm microgreens growing operation, which can be replicated elsewhere.</i>			
<i>Sub-goal:</i>	<i>Performance Measure:</i>	<i>Benchmark:</i>	<i>Target:</i>
<i>1a) Test a diverse variety of microgreens which work for this market.</i>	<i>a) The number of microgreen and shoot varieties tested and produced during project.</i>	<i>a) Two to three varieties of microgreens and shoots in place at start of grant period.</i>	<i>a) At least 12 to 15 varieties of microgreens tested; with at least 5 to 7 selected and sold in project by end of grant period.</i>
<i>1a) Actual:</i>			
Tested 20+ varieties of crops for microgreens. Though some germinated well, the yield was not enough to justify the seed cost. Narrowed down to 6 choices for high yield and compatibility in different temperatures/seasons. Three varieties sold to commercial buyer and eight sold in farm share program.			
<i>1b) Identify and document issues in planting and growing.</i>	<i>b) A well-documented planting and growing system which identifies challenges and needs.</i>	<i>b) Identify and document issues in planting, harvesting and packing at start of production to be tested.</i>	<i>b) Test and finalize at least two planting systems and harvesting tools; Outline processes needed for all forms of packaging required by buyers during project.</i>
<i>1b) Actual:</i>			

The following issues and solutions are documented in the Guidelines for Growing document we created for other farmers.

1) Beds: We tested various style of growing structure, using trays with coir then soil based beds. After trials, settled on sandwich bed construction on nursery tables of wood frame, landscape fabric, insulation, heat mat, landscape fabric, soil. In addition, we added metal framework over the top of the beds and plastic to form a low tunnel structure for more warmth in winter and to lower heating costs. Roll up bars on the side allow adjustment for temperature for plastic end walls allow us to keep the daytime and nighttime temperatures more consistent. Materials for this construction were relatively inexpensive, constructed on site by staff, and could be easily replicated by any farmer.

2) Growing Media: We began by using coir, as used by other operations; which did not yield good germination nor growth. We found that returning to healthy soil as medium yielded much greater result. Native soil mixed with compost became the solution. After a harvest, we turned over the soil, and dumped any debris into microgreens compost pile to decompose, putting nutrients back into the soil. This soil was then reused in the beds as growing media.

3) Watering: We found that keeping a perfect balance of moisture to dryness was constant checking of the soil – up to three times per day in the summer when heat intensified and dryness occurred. The fan system also helped keep the beds cooler and prevented fungus in the cool months. Watering with a long necked nozzle with spray type modification proved to be the best way to water. Documentation of watering patterns throughout the year is helpful to the farmer.

4) Documentation: Documentation was important not only in trialing seeds, media, and growing conditions, but during later steady commercial production as well. Keeping good notes, not just numbers on all the variables was key to seeing what types of systems worked best in our setup. We recommend to other farmers to do the same. We created forms for tracking in several phases of our trials, and they are shared in the Growing Guidelines document.

5) Harvesting: After experimenting with harvesting tools (see below) and final construction of bed design and growing media, we found that the same techniques we use for harvesting other produce worked well for microgreens. We found that a quick harvest was necessary to get the microgreens into water then the cooler after harvesting to prevent them wilting.

6) Processing: It was important for the microgreens to be clean but fully dry of water before they went into the packaging, otherwise, they would decompose faster and have shorter shelf life and were not attractive to our buyer.

7) Packaging: Our distributor/buyer required several items in packaging that we had to provide that was not anticipated: Tamper evident packaging, and individual boxes for each bag of microgreens. This was more waste and cost than we had in mind, but was necessary to sell our microgreens to the buyer. We originally had envisioned selling in large bulk bags, but that wasn't feasible for individual customer purchasing from the distributor and shelf life is longer in small, perforated bags.

1c) Identify ideal tools and equipment for microgreen growing and harvesting.

c) The number of harvesting tools, and other equipment tested and finalized during project.

c) Identify initial harvesting tools and equipment needed for initial start-up operation.

c) Test and finalize harvesting tools and equipment based on project experience. Document final preferred items to share with others.

1c) Actual:

The following equipment and tools were researched, tested and selected and are documented in the Guidelines for Growing document for other farmers. These are the elements we see as necessary equipment for a successful microgreens operation using our methods. However, as farmers

have different equipment resources available to them, they may be able to achieve the same result with different equipment. Shipping containers, garages basements also work but only if using grow lights.

1) Hoophouse: First and foremost, one has to assume that a farmer has a hoophouse or greenhouse available in their operation to grow the microgreens on a larger scale, especially in non-summer months. We discovered it is possible to grow them on bed tables in shaded areas without cover, but there will not be adequate supply throughout the year to begin to sell on a larger scale. The assumptions for this project and for the Growing Guidelines are that the operation is taking place in a hoophouse or greenhouse type of structure that has some semblance of temperature control and cooling adjustment, such as raise able side walls or louvered vents. There are many options for constructing a hoophouse that range from low cost and recycled materials to large pre-made kits that are assembled by professionals.

2) Elevated growing area: Though not absolutely necessary, it is much more convenient and easier for the farmer to work on elevated table like bed structure for the microgreens seeding and harvesting than it is to work on ground level. Whether the platform is made from recycled materials or professional rolling tables, an area that is elevated and that can be accessed down each side, is needed. Also, the width of the growing bed should be no wider than the reach of the farmer, from each of the accessible sides.

3) Heating System: After research, we determined that there are many options to heat the growing area, but that hot water fed heat mats (see below) were the most efficient direct heat option. After examining several options to heat the water, such as electric, natural gas, solar and bio gas, we decided to install a biogas heating system with an electric hot water heater as backup and support.

4) Heat Mats: We tested bed areas with an electric agricultural heat mat during the winter and found it an effective way to heat the growing area without heating the entire hoophouse. We researched larger scale growing mats that would work on a hot water circulating system, which is more efficient and cheaper to operate than electric ones, and have developed a system to be installed in fall of 2015 prior to winter onset. Other farmers may have other tools already in place.

5) Harvest Tools: We experimented with different tools already used for harvesting other types of produce: harvest knives and scissors. Though other operations which use trays pick up the tray, angling it and cutting with scissors; and other, larger ones use electric knives; we found that grabbing and holding the microgreens by bunch and using harvest knife or scissors to cut. We also experimented with pruning shears to cut but found that they had to be sharpened constantly so were not efficient in the operation.

6) Water: Watering equipment for our system remained simple: long hoses that run the length of the tables with long neck spray nozzles were the best performers to be flexible and provide good coverage. Overheat drip type sprayers proved too costly to install and we had concerns about their flexibility and reach to entire bed area should we move tables.

7) Ventilation: We discovered that ventilation by large fans was essential to prevent both fungus in winter and keep microgreens cool in summer. They act to keep growing area at an event temperature and moisture levels, to which the farmer can react. They are essential to the growing success of the operation. The fans we use are range from simple large household box fans to larger barn fans on rolling stands that can be placed and directed to different areas at different speeds as needed.

8) Processing Area: We developed the two sink processing system to wash and dry the microgreens. The process of processing the greens is: the harvest goes into one sink for an initial rinse then moved to the second sink to remove any seed debris. Then microgreens are run through a commercial salad spinner to remove excess water. They are then laid on a clean food grade surface area, which for us, was a countertop covered in clean paper towels. They are then dried with a fan thoroughly until they are packaged. Packaging the microgreens while still wet causes them to decompose faster in the packaging. One needs all these components in some form for successful processing.

9) Packaging: Based on the distributor's requirements, we needed tamper resistant packaging that also would breathe to prevent the microgreens

from getting soggy and last longer after packaged. We settled on micro-perforated food grade bags that are sold as bakery bags, and an inexpensive heat sealer to seal each bag. They are easy and safe to use and we would recommend them to other farmers.

10) Refrigeration: Microgreens need to be refrigerated both after harvest and after packing. ECO already had a walk in cooler installed on its farm. However, a used household refrigerator would work fine for this purpose.

<i>1d) Identify issues with pests, diseases and common solutions.</i>	<i>d) The number of common diseases and pest issues which are identified and number of successful solutions researched and tested.</i>	<i>d) The number of common diseases and pest issues solutions known at the beginning of the project.</i>	<i>d) Identify at least three common diseases and pest issues solutions known to the industry.</i>
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d) Actual:

1) Fungus: As indicated by interviews with other growers, we experienced fungus issues in the growing system, especially in cold months, due to uneven airflow and microclimates occurring in the hoop house caused by angle of the sun and its duration of contact throughout the day.

Microclimates also caused dryness in some areas.

The solution was installing large fans to create airflow throughout the hoop house and homogenize air temperatures and moisture levels. The fungal/dryness issues were mostly eliminated with this solution. The second part of the solution was when a portion of the beds got broke out in fungus, we exposed the bed to the sun for a week, this ‘solarizing’ would clear out the fungus.

2) Pests: During the summer, we experienced a small amount of army worm invading the microgreens beds. The solutions we found was to harvest the microgreens before day 7, when they emerged, or pick them off if found beforehand. These were not an issue in cold weather.

We did not encounter any issues with other pests. We noticed that birds liked sunflower seeds so when plant those for shoots, we recommend covering the bed area with bird netting, which was an effective deterrent.

<i>1e) Grow microgreens of a consistent, high quality and quantity that meet market needs.</i>	<i>e) The quantity in pounds and variety of microgreens grown weekly.</i>	<i>e) By end of year one production moved from testing into consistent per week poundage, beginning at 10 pounds per week.</i>	<i>e) Production to reach 300 pounds per week by end of year two. Steady production growth to meet demand throughout year two.</i>
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1e) Actual:

Production successfully moved from testing phase to consistent production phase with a weekly commercial sales client. Steady, consistent, high quality microgreens are being grown for the commercial market at ECO. Production was limited by end of Year 2 of grant by amount of demand from current commercial buyer, which was 15 pounds per week.

Calculations of available table space for further growing shows that we overestimated the overall capacity of the operation in our initial proposal: it is now closer to 100 pounds per week.

Goal 2. Logistics: Develop logistics system for successful microgreens delivery to buyers which can be replicated by others. Identify and document steps for ideal schedules, harvest and processing, transport and delivery, tracking and financial procedures, and buyer needs.

<i>Sub-goal:</i>	<i>Performance Measure:</i>	<i>Benchmark:</i>	<i>Target:</i>
<i>a) Structure an efficient harvest and processing process shaped by needs of buyers and available resources at ECO.</i>	<i>a) A documented harvest, process and delivery system for microgreens is in place that meets each type of buyer's needs and uses ECO's resources effectively.</i>	<i>a) By end of year one, have an initial harvest and processing plan and weekly schedule based on initial testing.</i>	<i>a) By end of year two, a final harvest and processing plan and schedule is complete, based on project experience, and is ready to be shared with other small farmers.</i>
<i>2a) Actual:</i>			
<p>Overall, we developed an efficient seeding, harvesting and processing/packaging system that delivered just the right amount of microgreens requested by the buyer and other ECO needs. Amount of time spent each week is approximately 10 hours for the entire process. The following processes are documented in greater detail the Guidelines for Growing document (attached separately) that we developed for other farmers.</p> <p>Seeding: After experimentation, we recorded the number of days needed for proper growth before harvesting for each seed type that we finalized as a selection for commercial sale. Usually this ranged from 5-7 days, depending on the seasonal temperature, amount of sunlight and seed variety. Timing of seeding to be ready for the buyer's weekly pickup date was a process we had to continually monitor based on these variables and changing seasonable conditions and allow for unexpected slow growth of the microgreens.</p> <p>Harvesting: Harvesting was easily done using tools described in 1c (above) and was done on the day of the order pickup, unless the timing of the growth peaked before the pickup date. Harvesting just before packing ensured the freshest product going to the buyer.</p> <p>Processing and Packaging: Processing was done as described in 1c (above) and was done on the day of the order pickup. After drying the microgreens were bagged by weight, then heat sealed. A label was added, pre-printed with ECO information, but spaces for lot number and date of harvest. These were filled in on day of packing. Each bag was put into a small cardboard box, and folded closed. Each box was labeled with the same label with lot and date. These were requirements of the buyer (see below). Boxes were stored in cooler on site until pickup by the buyer.</p>			
<i>2b) Identify and record buyer needs and specifications for packaging: per pound, bulk, etc. noting what handling is needed for each.</i>	<i>b) Written guidelines established for packaging for each type of retailer and product format, such as delivering uncut seed trays, bulk cut greens, and packaged cut greens.</i>	<i>b) By end of year one, an initial plan and guidelines is drafted for responding to buyer's needs in the market.</i>	<i>b) Written guidelines on harvesting and packaging finalized and complete, based on project experience. They are ready to be shared with others.</i>
<i>2b) Actual:</i>			

These processes are documented in greater detail the Guidelines for Growing document (attached separately) that we developed to instruct other growers on our processes learned.

Quantities: The buyer wanted the microgreens packaged in individual units that would be sold to customers. The size of each unit ended up not being what we envisioned originally: as selling as ‘bulk’, i.e., multiple pounds. One half pound, or 8 oz. was what Sweetgreen wanted for their restaurants, and was the size Keany Produce also agreed to buy. This required portioning of the microgreens by weight.

Packaging: There was much more packaging required than we originally envisioned. Each unit had to be bagged then put into an individual cardboard box. We originally envisioned several bags per box, but the customer wanted individually boxed to protect the product during transport and storage. This added to overall unit cost and we felt added negatively to the waste stream, but was needed.

Breathable: The buyer advised us initially to use breathable bags, which we had intended to do. However, they suggested the micro-perforated type bags other lettuce/greens suppliers use.

Tamper resistant: After initially selecting bags with zip lock type tops and larger holes to breathe for the first delivery, the buyer requested that we move to tamper resistant packaging. This would be a type of packaging that needs to be ripped to be opened. He suggested a simple heat sealer that other small producers use. After research, we found bags normally used for bakeries, with micro-perforations that are also a type of plastic suitable to be used with a heat sealer. We found that these worked well and used them in our process.

Label: Each bag had to be labeled with ECO’s name and contact information, plus product name the buyer will use in their system, such as ‘rainbow microgreens’, as well as lot number. We created a labeling system that does this – copy of it is in Growing Guidelines document (attached separately).

Tracking Lot #: Besides the basic information about ECO, the buyer required that we include a lot number on each batch sold weekly, so that it could be traceable in case of a food safety incident (see 2c, below). Each lot was dated with formulation Year-number, so 2015-1 was the first lot sold, 2015-2, the second, etc. We created a tracking sheet for the lots which is attached as sample at end of document.

These processes are documented in greater detail the Guidelines for Growing document (attached separately) that we developed to instruct other growers on our processes learned.

2c) Identify issues with storage, spoilage and food safety issues.	<i>c) Written guidelines on types of issues identified with storage, spoilage and food safety concerns, with potential solutions to mitigate each.</i>	<i>c) By end of year one, an initial plan and guidelines is drafted for addressing food safety concerns, spoilage and storage issues.</i>	<i>c) By end of year two, final written guidelines on food safety concerns, spoilage and storage issues, along with solutions for mitigation, is complete, finalized and ready to be shared with others.</i>
2c) Actual:			

These food storage and safety processes are documented in greater detail the Guidelines for Growing document (attached separately) that we developed to instruct other growers on our processes learned.

Storage & Spoilage: The biggest issues identified centered on keeping microgreens long lasting after delivery by keeping moisture in balance in the package. Drying the microgreens thoroughly after washing was the solution for us before packaging. Also using breathable bags kept them from ‘sliming’ and spoiling early.

Food Safety: The issues and potential risks identified for food safety for the microgreens growing operation were the same as for any agricultural product on our farm: contamination from human and animal contact and spoilage due to lack of refrigeration. Washing hands before handling the microgreens, providing clean food contact surfaces during their processing and using refrigeration were the solutions we identified. The produce buyer wanted to be sure that our contact surfaces were washed and sanitized at least weekly and that the microgreens were stored at 38 degrees after harvest, before pickup. Creating a lot number for each batch of microgreens sold, with a record kept on a tracking sheet allowed us the ability to trace our produce after it left the farm. Additionally, during the produce vendor application process for Keany Produce, we needed to provide a Certificate of Insurance. Any farming operation wanting to work with a distributor would need operation liability insurance.

d) Identify issues with delivery chain of the operation.	<i>d) Written guidelines on types of logistical issues identified with delivering product from farm to buyer, including but not limited to transportation, schedules, tracking and receiving systems and human resource needs.</i>	<i>d) By end of year one, an initial logistics plan and outline of issues is drafted, to include issues mentioned at right.</i>	<i>d) By end of year two, a final logistics plan and guidelines is complete and ready to be shared with others.</i>
-----------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------

2d) Actual:

These logistics processes are documented in greater detail the Guidelines for Growing document (attached separately) that we developed to instruct other growers on our processes learned.

Refrigerated Transport: Transportation can be one of the costliest parts of produce distribution, in both time and money. We were assisted by the fact that our buyer, a produce distributor, was willing to pick up the microgreens order each week. For the most part, microgreens are small and light, so can be transported easily by a small vehicle. However, they need to be kept refrigerated as they wilt very fast if exposed to heat. So part of any transportation solution would be to have either a cooler or refrigerated vehicle to keep the microgreens at a constant cold temperature of 38.

Sales Receipts: We also created a sales receipt form that would track each order and each pickup – signed by the pickup driver. This acted as both an invoice and receipt of goods picked up. One copy would be given to the driver and one kept for records. After, these receipts would be compiled and sent as an invoice to the distributor. We were fortunate in that the distributor paid weekly on each order, without an additional invoice. For any operation, one would need a basic tracking system of sales receipts and invoices. See sample at end of document.

3. Financials: Identify, outline and document the financial elements needed for a successful microgreens production operation.

Sub-goal:	Performance Measure:	Benchmark:	Target:
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3a) Structure an efficient business plan to meet the needs of successful microgreens production operation and available resources at ECO.	<i>a) Written business plan which addresses all business components of the operation listed in sub-goal 3b, below, and uses available resources at ECO.</i>	<i>a) By month six of the project, an initial business plan is drafted and begun to be used in the operation.</i>	<i>a) By month 18 of the project, the business plan is finalized based on project experience, and prepared for sharing to others as a model for the microgreens production.</i>
3a) Actual: <p>These business processes are documented in greater detail the Guidelines for Growing document (attached separately) that we developed to instruct other growers on our processes learned.</p> <p>During the project period, staff created various financial tracking tools, identified microgreen growing operation costs, and a cost benefit analysis of the operation as a budgeting tool to see total project costs for a farmer. This budgeting tool includes capital improvements needed, assumptions, cash flow and predicted date of pay off or break even from the start-up expenses. A copy of this tool is at the end of this document. These tools, including budgeting tool are shared in the Guidelines for Growing and are in interactive formats with formulas to allow the farmer to add in their specific line items and expenses. Although we did not engage a business consultant to develop a formal plan, we feel we have identified the cost areas in a simple format for any farmer to use for a prospective operation.</p> <p>In developing the microgreens operation, we had specific resources on hand from the beginning that we used for a successful operation, such as a hoophouse and onsite farm staff that could run the operation. These are noted on the budgeting tool. Other farmers may have different farming resources in place, or need to budget for major capital expenses, such as a hoophouse. These are not insurmountable expenses if there is the market for the microgreen product, however the farmers would need the cash flow to float these expenses in first years. The budgeting tool allows the farmer to take that into consideration and helps frame out the break even point.</p>			
3b) Identify and document specific financial and business components needed for the operation, including but not limited to: i) billing, accounting and order tracking; ii) startup costs for equipment and staff; iii) establishing and formalizing relationships with buyers; iv) cash flow needs; v.) and additional overhead costs.	<i>b) Identification and documentation of specific business components needed as listed at right, and included in final business plan.</i>	<i>b) By month six of the project, identify and compile initial list of business components needed.</i>	<i>a) By month 18 of the project, final identified business components included in final business plan.</i>

These processes are documented in greater detail the Guidelines for Growing document (attached separately) that we developed to instruct other growers on our processes learned.

3b) Actual:

We identified needed financial tools, such as sales receipts and invoices to track orders during the sales process. These were created in Microsoft word. Although we use QuickBooks accounting software for our operation, a farmer could use a simple spreadsheet to track orders and payments from buyers. These tools are included in the Growing Guidelines document.

As noted in responses to 1c and 3a, above, we also identified and outlined equipment needed and costs, cash flow needs, overhead costs and operational costs in starting up and running a microgreens growing operation. This is formulated in a template style spreadsheet that allows a farmer to make changes in the line items and amounts, and have these costs amortized over a number of years. These tools are included in the Growing Guidelines document.

Goal 4. Report: Create a full report including lessons learned and all the documented guidelines listed in above goals for free distribution to area farmers.

<i>Sub-goal:</i>	<i>Performance Measure:</i>	<i>Benchmark:</i>	<i>Target:</i>
<i>a) Identify lessons learned and outcomes of the major areas above (production, harvesting, packing, logistics, financials).</i>	<i>a) All guidelines and documentation, listed in above goals, are included in the final report.</i>	<i>a) A draft guidelines are included in preliminary report by end of year one.</i>	<i>a) Final guidelines in production, harvesting, packing, logistics and financials are included in final report, based on project experience by end of year two.</i>
<i>4a Actual:</i> Included in the Guidelines for Growing document (attached separately) that we developed to instruct other growers on our processes learned.			
<i>b) Itemize any challenges faced by a small microgreens producer that will need to be addressed for a successful operation.</i>	<i>b) An overview of issues and challenges faced by a small microgreens producer is included in the final report.</i>	<i>b) A draft of initial issues and challenges is included in the preliminary report by end of year one.</i>	<i>b) A final overview of issues and challenges is included in final report, based on project experience by end of year two.</i>
<i>4b Actual:</i> Included in the Guidelines for Growing document (attached separately) that we developed to instruct other growers on our processes learned.			
<i>c) Provide tangible solutions based on both ECO's experience and research with other</i>	<i>c) Tangible solutions to all challenges and issues are included in final report.</i>	<i>c) Tangible solutions to challenges and issues are included in preliminary report by end of year one.</i>	<i>c) Tangible solutions to challenges and issues are included in final report by end of year two.</i>

<i>microgreens farmers.</i>			
4c Actual: Included in the Guidelines for Growing document (attached separately) that we developed to instruct other growers on our processes learned.			
<u>Goal 5. Education:</u> Actively educate area farmers and sustainable food professionals about microgreens model, lessons learned and guidelines created.			
Sub-goal:	Performance Measure:	Benchmark:	Target:
<i>Use all of ECO's existing and future networking, outreach and educational opportunities to provide information and a model to small farmers about successful microgreens production.</i>	<i>a) The number of visits by farmers to ECO's farm to learn about the microgreens project.</i> <i>b) The number of speaking engagements about the microgreens project.</i>	<i>a) Initially include microgreens project in weekly public farm tour at start of grant period.</i> <i>b) 0 speaking engagements about microgreens production at start of grant period.</i>	<i>a) Besides inclusion in weekly tour, host 2 tours per year for specialty farmers by end of grant period.</i> <i>b) 3 speaking engagements and conferences about successful microgreens production by end of grant period.</i>
5 Actual:			
<p>a. Tours: The microgreens operation is featured in our weekly farm tours, which are attended by a wide range of people. Other farmers and growers are especially interested in our heat mats and heating system. We have conducted 2 tours of the targeted 2 for specialty farmers which have reached approximately 200 people.</p> <p>b. Microgreens Growing Educational Session: On October 17 2015 we held a free two hour microgreens growing workshop to share our operation. This was led by ECO's farmer, the microgreen intern, and another local microgreens producer from Little Wild Things. Topics included space requirements, using flats versus beds, natural or artificial light, varieties of microgreens, harvesting and processing techniques, marketing to restaurants and farmers markets, fungus and pests, and distribution. There were ten attendees which included other growers and beginning farmers. Additionally, we will be looking to present results of the microgreens operation at area farming conferences during the winter. We have conducted 1 session of the targeted 3 sessions for specialty growers.</p>			

4. BENEFICIARIES

At time of writing, the number of beneficiaries learning about the project via the Microgreens Growing Session and farm tours, is approximately 210 people. However, with the completion of the Growing Guidelines, and a full season experiencing growing for the commercial market, we are now poised to share this growing process and lessons learned to other growers in the region who can replicate our system to gain additional footholds in the local food system.

The Guidelines for Growing document that we developed to instruct other growers on our processes learned is also located on our website at: <http://www.ecoffshoots.org/programs/farm-network/>.

5. LESSONS LEARNED

Many lessons were learned along the process of the grant project period, which are outlined in detail in the Project Approach section. However, some overall perspectives on lessons learned can be outlined here:

Setup will be Unique to Each Farmer: Our experience affirmed the initial lessons learned through research and interviews was that each grower had a different method, grew different crop varieties, and their packaging type depended on who is purchasing their product.

Mitigating Seasonal Fluctuation in Operation: This was a challenge we continued to face and affected our data tracking and production plans, such as seed selection and planting schedules for different times of the year. We needed to create a full yearly strategy to address fluctuations and will continue to improve our processes.

Data Tracking Needs to Fit Questions Asked: We had to keep modifying our data collection sheets to make sure they were providing long term information we need not just for months but over the cyclical course of the year with its seasonal fluctuation factors.

Advantages of Using Distributors: For our situation, working with a distributor was ideal. As is most likely with other types of produce, using a distributor for microgreens sales allowed us to concentrate on growing and not have to handle and deliver individual orders to local restaurants. Though we sold at wholesale prices, the advantages in saving time and money were much greater than if we handled individual restaurant accounts at retail prices. However, due to their requirements, there was much more packaging required than we originally envisioned that was needed to protect the product through the warehousing and delivery process. Their needs shaped our packaging system and helped us get up to speed quickly on standards.

A certain amount of equipment/ infrastructure needs to be in place for the operation: Whether a farmer has a hoophouse in place or funds available to construct one, would make a difference in the decision making process to start growing microgreens. Other items such as refrigeration and nursery benches would be additional larger costs. We outlined equipment needs we identified in the Growing Guidelines.

These lessons learned are in our [Guidelines for Growing](#) document that we developed to instruct

other growers on our processes, located on our [website](#).

6. CONTACT PERSON

Margaret Morgan-Hubbard, CEO, ECO City Farms: 301/288-1125; mmh@ecocityfarms.org.

7. ADDITIONAL INFORMATION

PHOTOS

Microgreens Growing System		
		
<i>Rolling nursery bed tables, installed</i>	<i>Beds and framework built on tables</i>	<i>Plastic endwalls and cover constructed to keep beds warm in winter</i>
		
<i>View of full nursery table with low tunnel like framework and plastic covering, before bed construction</i>	<i>Pilot heat mat to test heating system on first bed</i>	<i>Showing full 'sandwich layers' of bed construction: insulating reflective foam board, heat mat, landscaping fabric, soil. Ready for planting.</i>
		

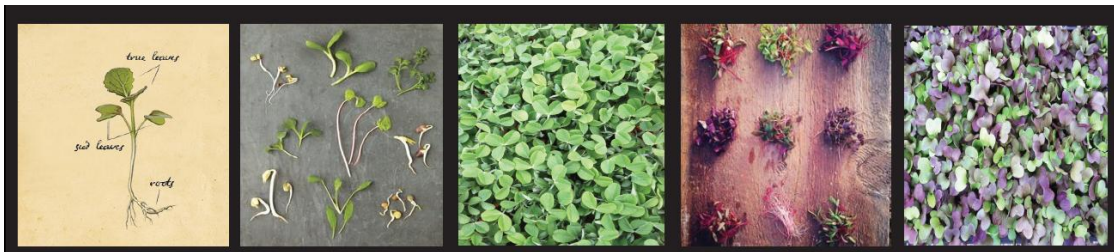
<i>Table bed with trial plantings of microgreens using soil in both trays and flat open beds.</i>	<i>Bed with microgreens growing</i>	
Harvesting System		
<i>Photo of harvesting</i>	<i>Tools and collection technique</i>	<i>Washing & bagging</i>
Packaging Systems		
<i>Photo of micro perforated bag</i>	<i>Photo of heat sealer</i>	<i>Photo of labeled bag in box</i>
<i>Photo of label</i>		

SEED TRIALS DATA TRACKING SHEET

Seed source

1A Varieties	Variety	Y or N	Notes						
2/28: 5/24: 6/14:	Kogane Chinese Cabbage	N	little germ in summer, no germ in winter						
2/28: 5/24: 12/1	Red Cabbage	N	not much germ - mildew/mold in late winter; however, heavier yield						
2/28: 3/14: 7/4:	Persian Cress	Y	higher yield than most, awesome flavor						
2/28: 9/17: 11/1	Cressida Cress	Y	grew well, awesome flavor, good fall						
2/28: 3/11: 1/14	Top Beet	maybe	Did well in winter - long germ time (1 month for size)						
2/28: 5/14: 6/14:	Yellow Beet	maybe fall crop	One tray in Nov = 02 !!						
2/28: 8/3: 6/11:	Cilantro	prob Not	would like to trial some more - maybe in the fh						
2/28: 5/14: 6/14:	Red Giant	N	other mustard varieties did better						
2/28: 3/14: 4/25:	Ruby Streak	Y	did well in spring, not well in summer, no diff in medium						
2/28: 6/21: 12/3	Suehling Mustard	N	other mustard varieties did better						
2/28: 4/25: 8/8: 1	Ruby Red Chard	possible	let grow two months Nov-Jan, heavier yield						
2/28: 3/14: 9/10:	red choi	Maybe	would like to trial again in the spring						
2/28: 6/2: 12/3	Red Komatsuna	N	no germination regardless of season						
2/28: 4/25: 6/3:	Komatsuna OP	N	Very little germination regardless of season						
2/28: 4/25: 5/14:	Arugula	Y	good for fall/winter, Try in spring						
2/28: 6/2: 6/14:	Rambo Radish	Y	need to trial some more but a heavier micro						
2/28: 3/14: 5/24:	Purple Kohlrabi	Y	cont to trial per season - did well in late fall						
2/28: 7/4: 8/8	Broccoli	Y	need to soak first						
	Sunflower								
	Peashoots	Y	Do well except for deep winter and heat of summer - will try fan						

Perennials = 115.60
 100 days = 16.98
 200 days = 94.62



Microgreens



Join us for an informational gathering on Microgreens where Mary Ackley, from DC's Little Wild Things, and Deborah Wren & Diana Agonoy of ECO City Farms will share their experiences growing microgreens, exploring the struggles of indoor and outdoor production, sales techniques and crop varieties.

Come learn from their successes and failures, get tips on how to produce small-scale or large-scale, and have a tour of our ECO City Farms production facility.

Saturday, October 17th, 2015

1pm - 3:00pm

@ ECO City Farms: Edmonston
4913 Crittenden St
Edmonston, MD 20781

Refreshments will be served
FREE! Suggested donation for our bees



Please RSVP to Deborah Wren at deborah@ecocityfarms.org by Saturday, October 10th to ensure adequate seating

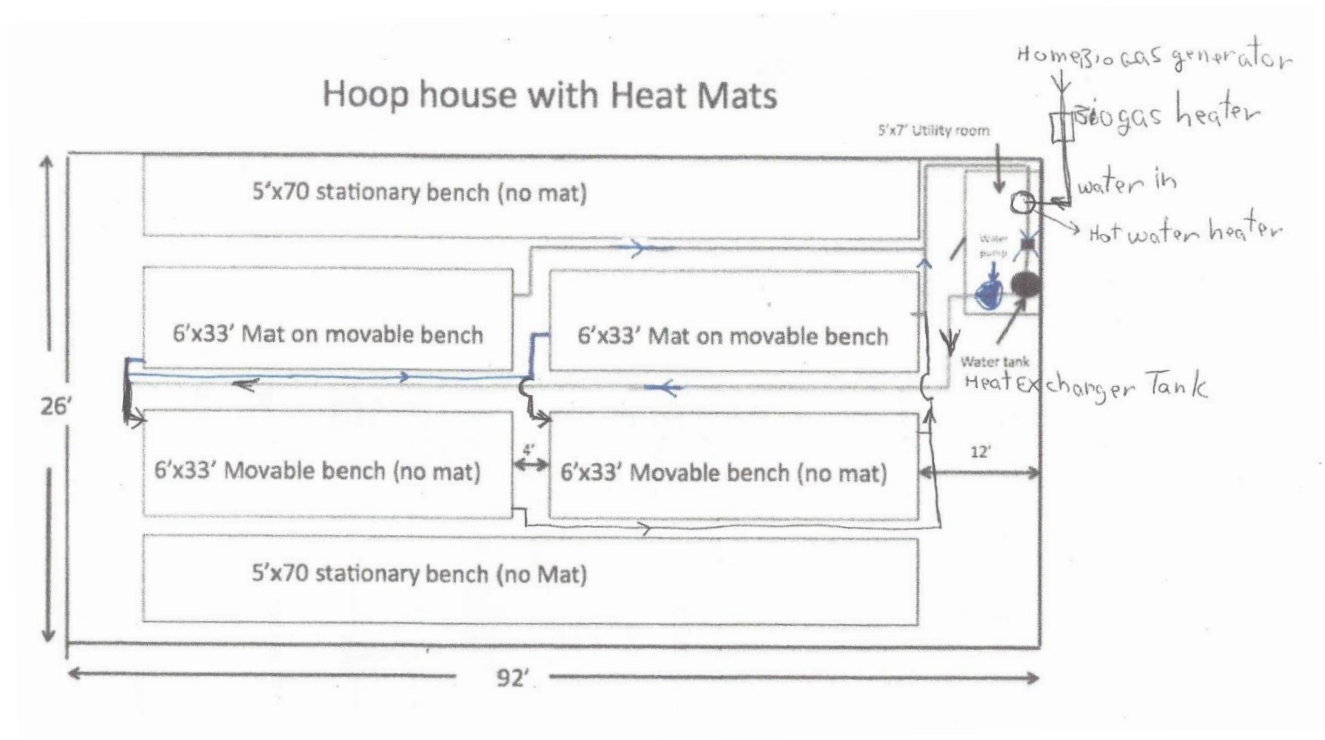


www.ecocityfarms.org | info@ecocityfarms.org



SCHEMATIC OF MICROGREENS NURSERY LAYOUT

Detail showing heat mat layout.



SALES RECEIPT

SALES RECEIPT

Date: 10/1/15



ECO CITY FARMS
6010 Taylor Road, Riverdale, MD 20737

Attn: Amanda West
304/703-2380 |
amanda@ecocityfarms.org

ECO Staff:

To be paid by:

Notes:

Deborah

Net 30 from date

Keep one copy for ECO, give one to Keany

Quantity	Description	Unit Price	Total
30	Mixed Microgreens, 8 oz bags	9.00	\$270.00
		GRAND TOTAL	\$270.00

RECEIVED BY: _____ for Keany Produce

SALES LOT TRACKING SHEET



ECO CITY FARMS 6010 Taylor Road | Riverdale, MD 20737
www.ecocityfarms.org | info@ecocityfarms.org
we grow great food, farms and farmers

MICROGREENS SALES LOT TRACKING SHEET

Please complete after each packing of microgreens for wholesale sales. Each planting and harvest cycle is a separate lot and should be assigned a number when harvested and packed for sale.

Lot # (put on label)	Date Packed (put on label)	Size of bags	Quantity	Sold To:	Date picked up:
1-2015				Keaney Produce	
2-2015					
3-2015					
4-2015					
5-2015					
6-2015					
7-2015					
8-2015					
9-2015					
10-2015					
11-2015					
12-2015					
13-2015					
14-2015					
15-2015					

ECO City Farms

Microgreens Operation Budgeting Tool

Oct-15

Gray cells contain calculations that should not be altered.

Company Data

Required rate of return	10%
Tax rate	0%

Initial Capital Investment in Microgreens Operation	YEAR	1	2	3
Nursery Benches		\$13,500.00		
Heating System		\$4,000.00		
Fans		\$300.00		
Harvesting and Packing Equipment		\$300.00		
Total Initial Investments		\$18,100.00		

Assumptions:

Existing hoophouse on farm

Existing produce bins

Income from Microgreens Operation	YEAR	Actual 1	Estimated 2	Estimated 3
Wholesale sales - Keaney Produce		\$28,080.00	\$28,000.00	\$28,000.00
Wholesale sales - Coastal Sunbelt		\$0.00	\$28,000.00	\$28,000.00
Direct Sales Farmers market		\$500.00	\$500.00	\$500.00
CSA stock		\$0.00	\$0.00	\$0.00
Wholesale sales - Whole Foods		\$0.00	\$0.00	\$14,000.00
Total Benefits		\$28,580.00	\$56,500.00	\$70,500.00

Assumptions:

Figures based on 4 months of sales, estimated rest of year

Year is from start of sales in July 2015

Costs (Excluding Initial Capital Investments)	YEAR	Actual 1	Estimated 2	Estimated 3
Microgreens grower salary*		\$0.00	\$10,400.00	\$13,000.00
Farm Manager time on project mgmt/customer communication/billing, etc.		\$1,768.00	\$1,768.00	\$2,652.00
Seeds		\$10,400.00	\$20,800.00	\$26,000.00
Soil Amendments & Supplies		\$1,900.00	\$3,800.00	\$4,750.00
Packaging		\$686.32	\$1,372.64	\$1,715.81
Tools and Equipment		\$300.00	\$600.00	\$750.00
Electricity & Water		\$300.00	\$600.00	\$750.00
[Other costs]		\$0.00	\$0.00	\$0.00
[Other costs]		\$0.00	\$0.00	\$0.00
Depreciation on Capital Expenditures		\$0.00	\$0.00	\$0.00
Total Costs		\$15,354.32	\$39,340.64	\$49,617.81

Assumptions:

*If we pay the microgreens intern

Existing farm management staff in place - fixed cost on mgmt weekly hours

Year 2 assumes selling 60 8 oz packages per week

Totals	YEAR	Actual 1	Estimated 2	Estimated 3
Net Income (Costs)		\$13,225.68	\$17,159.36	\$20,882.20
Tax		\$0.00	\$0.00	\$0.00
Value after tax		\$13,225.68	\$17,159.36	\$20,882.20
Depreciation added back		\$0.00	\$0.00	\$1,715.81
Cash flow		\$13,225.68	\$17,159.36	\$22,598.00
Cumulative cash flow		(\$4,874.32)	\$12,285.03	\$34,883.03

Evaluation Metrics

Net present value (NPV)	\$25,082.84
Internal rate of return (IRR)	71.11%
Payback period (in years)	1.28

FINAL REPORT

Project Title: Maryland Winegrape Portfolio Trade Tasting

Project Summary

The initial purpose of this project was to create and develop a strong relationship and market opportunity with Maryland and Washington D.C. sommeliers, wine buyers, chefs, restaurateurs, and wine shop owners. The Maryland Wineries Association (MWA) supports over 1,000 acres of vineyards throughout the state, and the goal was to further support local growers and focus much-needed attention on getting the fruit of Maryland's specialty crop growers in the hands of the trade.

The mechanism to develop greater interest in these products was to create, develop, promote, and manage a 2014 tasting open to members of the food and wine trade, featuring Maryland wine from Maryland-grown grapes. The event - branded "Maryland Wine Portfolio Trade Tasting" – was to be held annually. This annual event was to focus on Maryland grown grapes and help get more Maryland wine into local restaurants, hotels, and wine shops, to promote the growth and development of the Maryland wine grape industry.

The tastings were to be located in a suburb of Washington, D.C. near a metro stop so that members of the trade from Baltimore, Washington, D.C. Frederick, and other Maryland cities would find it convenient to attend. MWA also intended to extend personal invitations to retailers and trade members to attend a trade component at a major September 2014 wine festival.

The project was important, and timely, for Maryland because the growth in both vineyard acreage, and wineries using state grapes, has continued to grow at a steady rate. In 2013 there were 62 licensed wineries and more than 200 Maryland grape growers, representing over 1,000 acres of vineyards planted. Annual sales of Maryland wine in FY 2011 were estimated at \$24.4 million (estimated \$15/bottle on average). In 2015 there are now 77 licensed wineries, 165 vineyards (according to Maryland Grape Growers Association), and an 84% increase in Maryland production tonnage from 2010 to 2014. Annual sales of Maryland wine in FY 2014 were estimated at \$29.1 million. These numbers demonstrate that the project was, and still remains, extremely relevant to this sector of Maryland agriculture.

Project Approach

Grant activities included research, reevaluation and planning of the program's late commencement in January 2015. A PR firm—PurpleDot Public Relations—was hired in to assist in the promotion of local wine/grapes to members of the trade. They were integral to increasing the visibility of the industry and its products.

The program, which was originally slated to begin in early 2014, was delayed for several reasons. The staff manager of the project left the organization in December 2013 causing a disruption in the

planning of a number of the activities. The organization's board reevaluated the timeline of the grant program and decided to halt activity until a replacement was hired.

In October 2014 the board hired a new events and promotions coordinator who had experience in promoting agricultural products to members of the trade. Grant activity was able to move forward at that time.

A scope amendment was submitted to the Maryland Department of Agriculture (MDA) in February 2015. The goal for the amended program was the same: to increase retail/wholesale wine buyers' awareness of the varieties of grapes being successfully grown in Maryland. Rather than attempting to reach wine shop/restaurant owners via trade tastings, however, MWA's revised goal was to invite members of the trade to participate in a number of events spread across the state throughout the year. The audience MWA was attempting to reach was to be invited to participate in tours and have the opportunity to meet the winemakers and grape growers at the source, rather than at an annual single event. MWA intended to market to the trade through the *Maryland Beverage Journal*—the industry's trade publication. [Note: MDA did not submit the scope amendment to USDA since the goal of the amended program was still the same as in the state plan].

Since the start of the grant, demand for wines and other products like ciders made from agricultural products other than grapes (i.e. honey and apples) have increased in the marketplace. The definition of mead (honey wine) states: Under the regulations implementing the labeling provisions of the Federal Alcohol Administration Act (FAA Act), the standards of identity for wine made from the fermentation of agricultural products other than fruit are set forth in 27 CFR 4.21(f). Pursuant to these regulations, a product designated as "honey wine" must be derived wholly (except for sugar, water, or added alcohol) from honey. Wines designated as "honey wine" under 27 CFR part 4 also may contain hops, consistent with the levels set forth in part 24.

The definition of cider states: The terms "cider" and "hard cider" refer to wine fermented from apples (including apple juice or concentrate). Because the Alcohol and Tobacco Tax Trade Bureau (TTB implements the FAA Act), treats cider and honey wine like wine for registration and labeling purposes, these Maryland mead and cider producers must register as a bonded winery. This led to cider and mead producers in the state becoming part of the Maryland Wineries Association (MWA); as a result, MWA's promotion materials started to include mead and ciders. These producers make up a very small percentage of the organization and the marketplace. Cider and mead meet the definition of specialty crop processed products.

The Restaurant Association of Maryland (RAM) played a very important role in this project by offering the opportunity for MWA to be its sole sponsor at a January 2015 Taste of Maryland reception for Maryland legislators and members of the trade. At this event, MWA members were able to have more focused conversations with retailers and restaurateurs who may have only had limited experience with Maryland wines. Additionally, legislators had the opportunity to learn of the existing wineries and vineyards in their local areas, and the economic impact of those businesses and the industry overall.

Goals and Outcomes Achieved

MWA conducted a wide-range of activities intended to meet the performance goals and outcomes identified in the grant:

- February 2014: MWA and Maryland Grape Growers Annual Meeting. Conducted a “New Winery Start-up Seminar” attended by approximately 25 people that offered information on tapping into retail markets.
- January 19, 2015: The Restaurant Association of Maryland “Taste of Maryland Reception” provided the opportunity for the 25 restaurants in attendance to develop a greater awareness of Maryland grape varieties and the quality wines being produced across the state. The restaurants were also able to make one-on-one connections with wineries. Additionally, the 75-100 legislators who were in attendance also learned about the existing wineries and vineyards located in their counties, and the economic benefit they provide.
- February 2015: MWA and Maryland Grape Growers Annual Meeting. Conducted a “New Winery Start-up Seminar” attended by approximately 25 people that offered information on tapping into retail markets. Also offered a session on “Marketing and Increasing Market Share” attended by approximately 20 people. This session addressed issues of more innovative strategies to market wines and wineries.
- April 19, 2015: We Pour Local Trade Show - 51 representatives of the restaurant and retailers industries attended. MWA captured information from all attendees.
- July 16, 2015: MWA attended the Governor’s Buy Local Picnic, which included selected local restaurants and chefs who paired Maryland wines with locally-produced dishes. The Buy Local Picnic is the kick-off event to Maryland Wine Week and the Maryland Buy Local Challenge. More than 100 attendees attend this annual event.
- July 18-26, 2015: organized and promoted Maryland Wine Week activities, including winery and retail events, tastings, press releases and marketing materials. Proclamation from the Governor celebrating the week.
- September 19, 2015: At the Maryland Wine Festival - the largest, and longest running wine festival in the state – a concerted effort to encourage trade representatives to attend resulted in more than 40 retailers attending, which gave them the opportunity to sample wines from more than 25 participating wineries.
- November 9, 2015: The Maryland Governor’s Cup announcement and awards ceremony was hosted at the Wine Source, a local retailer who has committed to purchasing increasing amounts of Maryland wine. Local press attended the event.
- MWA Membership Dial-In Sessions. These phone calls are offered to provide topic-specific trainings, featuring industry experts. The following Dial-In sessions offered trainings related to the grant goals:
 - March 2014: Topic - How to communicate with retail accounts, and self-distribution.
 - April 2014: Topic - Marketing and promoting your winery to retail and events.
 - May 2015: Topic - Use Maryland Wine Week to grow your business to your own advantage.
 - June 2015 Topic - Maryland Wine Week activities your winery can undertake: events, retail partnerships.
- Marketing & Public Relations Activities:
 - Invited members of the trade to all regional events.

- MWA became more active at winery openings to draw attention to the industry as a whole.
- The MWA Wineries of Maryland Passport was completely revised and reprinted in 2015. The passport focus was expanded to include information that retailers and restaurants would need to know in order to easily develop buying relationships.
- In 2014 a “We Pour Local” map of the Maryland Wine Trails was developed and distributed to wineries sales representatives, and any retailers who attended 2014-2015 events. The map’s purpose was to visually inform consumers and retailers that 1) a wide variety of grapes are grown in every county in the state, 2) consumer-friendly wine trails exist throughout the state, and 3) Maryland wineries produce a vast range of styles for every palate.

Goals Established	Actual Accomplishments
Increase wine consumer acceptance and familiarity of Maryland wine by hosting one trade tasting for at least 200 members of the trade. A Maryland wine trade tasting has never been attempted.	Goal changed to increase wine consumer acceptance and familiarity of Maryland wine by hosting at least 200 members of the trade at events around the state. A review of event lists indicates that more than 200 trade representatives attended events during the grant period, primarily at established wine promotional events (85%), but also at the new trade show (15%).
Increase restaurant acceptance of Maryland wine by having 25% more restaurants carry Maryland wine 6 months after the tasting, up from 300.	Maryland wineries have done an increasingly good job of listing on their the website the restaurants that carry their products. While MWA was not able to document a 25% increase in restaurant acceptance of Maryland wines, 15% of wineries indicated that they are getting more inquiries from local restaurants.
Increase retailer acceptance of Maryland wine by having 40% more shops and businesses carry Maryland wine, up from 800.	Maryland wineries have done an increasingly good job of listing on their the website the retail outlets that carry their products. While MWA was not able to document a 40% increase in retailer acceptance of Maryland wines, 30% of wineries indicated that they are getting more inquiries from local retailers, whose Maryland sections have been growing in size.
Increase in participants in Maryland Wine Week up by 25% from 2013 to 2014.	In 2013, 40 wineries, retailers and restaurants participated in Maryland Wine Week activities. In 2014, Wine Week participation by businesses and organizations increased to 60 due to greater promotion, representing a 50% increase in the number of businesses participating.

Increase market share of Maryland wine.	The 2014 Comptroller's Report documented a 11.6% increase in sales of Maryland wines from July 2013-July 2014, giving Maryland wineries a 2.58% market share, versus the previous year's level of 2.33%. Although this number remains small, it does demonstrate the continuing growth of local wine sales. As MWA events continue to grow in both attendance and wine sales, it is clear that the Mid-Atlantic region customer is buying more local wine. This growing number will encourage local retailers and restaurants to invest the time and energy to source these products.
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Beneficiaries

The Maryland wineries and grape growers were the primary beneficiaries of this project's accomplishments, both for MWA's increased focus on promoting events, as well as offering more targeted training and information on accessing retailer and restaurant businesses. In 2015 there are now 80 licensed wineries, 165 vineyards, and an 84% increase in Maryland production tonnage from 2010 to 2015. Annual sales of Maryland wine in FY 2014 were estimated at \$29.1 million. A trade show is still a future possibility, but the activities undertaken created a potential multiplier effect of creating more consumer demand, which could better drive trade demand.

Lessons Learned

One of the primary lessons learned was the realization that the trade show idea, while good in concept, was not quite ready to be implemented. Although interest is growing, it demonstrated to MWA staff that a more critical mass needs to be created before trade representatives can be pulled into a large, one-day event like this. However, this forced MWA to become more creative in its outreach to restaurants and retailers, and it created a positive opportunity to meet retailers and restaurants in their local communities, at more local events. Additionally, MWA wineries themselves learned of the more critical role they have to play in their own promotion and marketing to the trade, and the special trainings gave the wineries the tools to do so.

Another lesson learned was the importance of having all MWA staff involved in the grant implementation. The early loss of a staff member from the project created a vacuum, and although the scope of the grant was changed, some of the energy and time needed was never regained. As a result, MWA staff collaboration has increased, with each staff member taking on responsibilities.

Additionally, the industry as a whole realizes that a self-distribution model will never create the market penetration needed to drive market share to much higher levels. It is clear that innovative

models to consolidate and distribute product need to be developed. Retailers and restaurants often pick up a phone and make one or two phone calls to meet all of their product needs, and the current system where a trade member who wants 10 Maryland wines needs to make 10 different phone calls, prevents those buying relationships from ever happening.

Contact Person

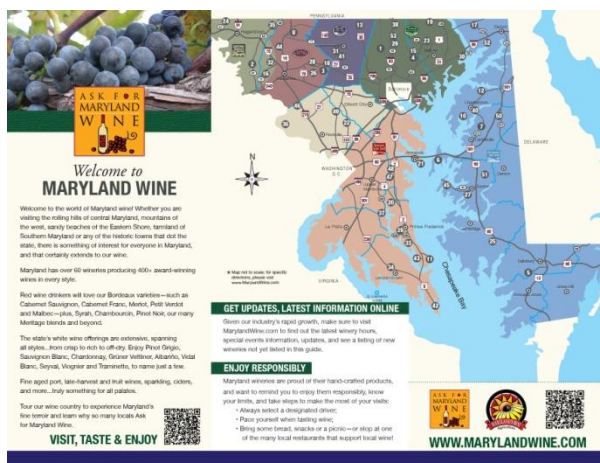
Kevin Atticks, Executive Director, Maryland Wineries Association
410-252-WINE (9463)
kevin@marylandwine.com

Additional Information

2014 We Pour Local Map / Poster:



2014 Maryland Wine/Grape Passport:



2015 Maryland Wine Week Point of Sale Cards for Retailers:



The card features a background image of a vineyard with rows of grapevines under a blue sky with clouds. The text "drink local wine•cider•mead" is overlaid on the image. Below this, a paragraph describes Maryland Wine Week as a celebration of local wine, hard cider, and mead produced by over 65 wineries. It encourages supporting local businesses and spreading the word about the great fermentations happening across Maryland. The event dates are listed as July 18-26, 2015, and the website MARYLANDWINEWEEK.COM is provided. A vertical banner on the right side of the card reads "BE A LOCAPOUR" and includes a QR code and a small logo for "ASK FOR MARYLAND WINE".

drink local
wine•cider•mead

Maryland Wine Week is a celebration of Maryland wine, hard cider and mead produced by our 65+ wineries throughout Maryland. You like good things. Good food. Good company. Good wine... Maryland Wine Week is our chance to support the businesses that produce and pour local wine and spread the word about the great fermentations happening across Maryland.

MARYLAND WINE WEEK
JULY 18-26, 2015
MARYLANDWINEWEEK.COM

BE A LOCAPOUR

ASK FOR MARYLAND WINE

015 Maryland Wine Week for Trade:



BE A LOCAPOUR

**CHARDONNAY • CABERNET SAUVIGNON • VIOGNIER
PETITE VERDOT • ALBARIÑO • CHAMBOURCIN
PINOT NOIR • MALBEC • PINOT GRIS • VIDAL BLANC
SYRAH • BARBERA • HONEY • APPLES • PEARS
SANGIOVESE • NEBBIOLO VIGNOLES • MERLOT
SEYVAL • SAUVIGNON BLANC • GRÜNER VELTLINER
MONTEPULCIANO • CATAWBA • CABERNET FRANC
BLAÜFRANKISCH • RIESLING... *and many more...***

Learn who we are and what we grow by visiting MarylandWine.com. See our wineries, wine trails and visit the “Learn More” section to read about our masters of wine, cider and mead and the locally-sourced agricultural products grown throughout Maryland.



**MARYLAND
WINE WEEK**
JULY 18-26, 2015

Join us...pour local: MARYLANDWINEWEEK.COM

FINAL REPORT

Project Title: Maryland Specialty Crop Distribution Hub Project

Project Summary

Maryland is known for its rich agricultural history, yet studies show that Maryland farmers are not meeting the demand for local food. This is especially true in Southern Maryland, which lacks a strong food distribution system and has unique issues of scale, infrastructure, and marketing. In order to create a food system which more effectively and sustainably meets the needs of Maryland consumers and farmers, the Southern Maryland Agricultural Development Commission (SMADC) proposed to research and plan a regional Food Hub, with a focus on producers in Southern Maryland. This would 1) expand and revitalize the farming community, 2) increase the capacity to meet consumer demand for locally sourced food, 3) ensure that farmers receive adequate payment for their products, and 4) create a distribution system that is financially, geographically, and structurally effective for consumers of all income levels. To ensure plan viability, SMADC's Specialty Crop Distribution Hub Project worked with key stakeholders such as local table crop producers, community institutions, retail and wholesale outlets, citizens, distributors, and anti-hunger groups to quantify the short- and long-term needs of each stakeholder, identify critical infrastructure, and create an efficient, financially sustainable Food Hub business plan. We are calling the Food Hub, the "Agricultural Business Park and Food Innovation Center" (aka "Ag & Food Innovation Center" or "Center"). The remainder of this document will refer to it as the Center.

One important aspect of SMADC's work is to help farmers enter new markets to increase sales and improve financial sustainability. For efficiency purposes, most food distributors prefer to purchase from mid-to-large sized farms which have larger quantities, efficient aggregation/transportation systems, and more certifications. In Southern Maryland, most farms are small and distant from metropolitan areas, and our regional distribution, transportation, and storage systems tend to be underdeveloped. These issues inhibit many Southern Maryland farmers from expanding their business by selling through indirect distribution systems. For example, SMADC approached several wholesale regional distributors to bring Southern Maryland farmers into the wholesale market, but found the distributors were only able to work with producers capable of low costs, high volume, and self-transport.

Though support on this grant, SMADC reached out to the farming community to expand the number of producers, promote agricultural growth, and discuss the concept of a Food Hub to distribute goods within Southern Maryland (Ann Arundel, Calvert, Charles, Prince George's, and St. Mary's counties), and to consumers in Maryland, the DC region, and other areas.

The Center is intended to benefit Southern Maryland by: 1) enhancing farmers' profitability, 2) enabling entry to bigger wholesale markets, 3) increasing the region's capacity to meet consumer demand for locally produced foods, 4) expanding and fortifying the region's multi-cultural farm community, 5) enabling businesses to develop and expand using local farm products, and 6) creating new jobs for the region. The Center plan is structured in a way to give farmers and rural

business a voice in the Center and its success and we are committed to providing farmers a fair price and/or return for their food.

The goal for the Maryland Specialty Crop Distribution Hub Project is a viable plan for a Southern Maryland Food Hub including business, infrastructure, and management plans. To create this plan, we set out to research the following questions:

1. How can we build up the regional supply of local produce by providing producers with a reliable wholesale market which would enable them to further expand their businesses?
2. How can we produce a wider variety and supply of goods for various consumers?
3. How can we better distribute or store larger quantities of food at harvest?
4. How can we educate communities to most efficiently utilize available foods?
5. How can we financially support the Food Hub activities addressing food insecurity?

In turn, the goals and objectives for the Center itself (not within the lifetime of this funding opportunity) include:

Goal 1: Promote Local Food Farmer Sustainability

SMADC will need to determine the basic requirements for farmer sustainability to ensure success of the Center. A detailed understanding of farmers' needs will allow us to work effectively with the agricultural community and also presents us with an exciting opportunity to shape creative solutions to the problems facing sustainable food distribution. SMADC believes that by offering assistance, financial incentives, and a committed market outlet for farmers to sell their fresh products, the economic viability of our specialty crop farmers will be enhanced, which will increase the regional economic income and food security. Objectives include:

- To create a strong, dynamic producer base which provides consistent, nutritious goods for consumers by providing incentives for farmers
- Boosting market impact of local farm foods by targeting products to meet market needs through identification and communication of unique community food requirements, which may be influenced by income, geography, traditions, etc.
- To expand support for local farm products by enhancing market access through improved distribution, thereby ensuring regional food sustainability

Goal 2: Ensure Food Hub Financial Sustainability through Innovative Marketing

In order to create a sustainable Center, the Center will have to bring in enough revenue to cover its expenses. Predominantly revenue to the Center will be in the form of rental spaces to the processors, distributor and vendors. Long-term financial sustainability will come about through market diversification and total product use. This means the Center will sell to both retail and wholesale markets while also selling "imperfect" items. As such, objectives for this goal include:

- To provide farmers with effective incentives to encourage continued business partnerships with the Center system
- To provide fresh, local foods to retail communities to generate revenue necessary to financially support other Center activities
- To identify innovative, efficient strategies for product marketing and distribution
- To minimize food waste by selling imperfect food items at a lower cost

Goal 3: Provide Nutritious Food to Food Insecure Networks

Maryland residents may be food insecure due to insufficient finances or physical lack of access, and this food insecurity has resulted in low-income communities with inadequate nutrition and diet-related disease. Many food-insecure residents have turned to local food banks/pantries for provisions, however, our local food pantries have communicated that they do not have consistent access to enough fresh, nutritious foods (predominantly from specialty crops) due to difficulties with supply, storage, and distribution. Objectives for this goal include:

- To gain a deep understanding of the current regional food infrastructure and community nutritional needs to ensure food distribution efficiency
- To improve low-income community health by expanding the supply, storage, and distribution capacity/methods of fresh foods to local food banks and pantries

❑ Describe the importance and timeliness of the project.

Southern Maryland is geographically well-situated to the large Baltimore-Washington Metropolitan region which has a \$26 billion annual food budget. Southern Maryland farmers could benefit far more from this demographic base than they currently do. Thus far, Southern Maryland farmers have been successful in reaching consumers via direct sales to consumers at roadside stands, farmers markets, CSAs, small grocery stores, etc., however, our farms have not been as successful in marketing to larger outlets, such as institutions and retail markets. Existing farmers attempting to sell through the wholesale markets find themselves bumped out by cheaper product grown long distances from our region.

For several years, the USDA has been documenting food hubs in the U.S. and making this information available to the public. As yet, no one prototype has been identified which can be applied to all situations. What makes our approach unique is that it builds on years of work by SMADC and our farm communities. Since its inception in 2000, SMADC has worked extensively with key stakeholders on the topic of food production and distribution. We have strong connections with specialty crop producers, farmers markets, academic institutions, local food retailers, large-scale distributors, anti-hunger groups, and social services. We know that farming communities want to increase sales through better regional distribution, large-scale distributors want more local partnerships, and anti-hunger organizations have communicated the need for fresh, local foods. In addition, new food safety requirements are coming. SMADC is investigating means to provide technical assistance through the Center for “GAP” certification for growers, if necessary.

SMADC is concerned about the future of farming, and as such has emphasized the need for new and young farmers in our region. For example, in Calvert county, 32,000 farm acres have been preserved, yet there are only 7 farmers under the age of 35. New and young farmers have identified multiple barriers in starting farm operations, lack of access to land, resources, and markets being high among them. SMADC works with partners to provide expensive farm equipment that can be shared by many farmers through its Farm Share program, and facilitates bulk-purchasing for needed vines, feed and other necessary items, thereby diminishing the high cost of production. SMADC provides a new farmer mentor program, and is developing partnerships to secure land for new farmer incubation. The Center, as envisioned, would provide an outlet for markets of specialty crops.

❑ If the project built on a previously funded project with the SCBGP describe how this project complimented and enhanced previously completed work.

The project did not build on previously a funded project with the SCBGP.

Project Approach

The Agricultural Business Park and Food Innovation Center Concept Plan:

The Southern Maryland Agricultural Development Commission (SMADC) has worked for 14 years to provide resources to farmers to be profitable, support land preservation, grow new farmers, and foster healthy food, farms and communities. With our partners, SMADC has helped individual farms and the community transform to a new economy based on food, beverages, equine, tourism, green products, and natural resources.

Over the years, SMADC has held many public forums and focal group discussions, and invited public input into our strategic plans. Consistently, the community has asked SMADC for help with food processing and distribution, navigating complex regulations, and assistance for new and transitioning farmers. The Agricultural Business Park and Food Innovation Center (aka Food Hub) is the next logical step.

To prioritize the needs of the community, during this grant period, SMADC held 23 public meetings in all five counties of southern Maryland to discuss and engage the community on the Center. SMADC also developed and distributed a written and digital survey (survey questions attached) in 2015. From this, a draft business plan concept for the Center was developed.

Center Project site: In the early winter of 2015, attorneys with the Maryland Office of Attorney General determined that the Tri-County Council and therefore SMADC did not have authority to purchase property. The Southern Maryland Delegation successfully introduced a bill (SB 909) to allow SMADC, through the Tri-County Council, to use funds to purchase, lease or lease-to-buy real estate for this project. The bill requires that a public search for property be conducted, as well as a public search for an entity to hold title adhering to state procurement policy. Several offices of the Maryland Attorney General's office have been engaged in interpreting the bill language. In the summer of 2015, two public requests for an "Expression of Interest" (EOI) for the site location were issued for sites anywhere within the five-county area. Objective technical criteria was developed to evaluate the EOI applications, and an advisory panel was selected to make prioritized recommendations in the selection process in mid-summer of 2015. Thirteen sites were submitted for review. In late summer, attorneys determined that, in accordance with state procurement law, the site could only be selected by the entity that would ultimately hold title, and therefore SMADC changed course to draft a Request for Proposals (RFP). The first version of the RFP is under review (as of this grant reporting). The final selection of the site will determine the final business plan to address site specific infrastructure needs. During 2015, SMADC developed a dedicated webpage for the Center on the SMADC website at www.smadc.com for updates on the project.

Distribution of specialty crop "seconds or surplus": Increasing access for the Hunger Community:

The Hub and Spoke program was initiated to bring fresh farm food to the hunger community, while enhancing profitability for farmers. The Hub and Spoke Task Force formed in FY'12 to identify effective ways to improve distribution of fresh, locally grown produce to food insecure families in

Southern Maryland. Staffed by SMADC, the Task Force researched and developed an effective plan for a “Hub and Spoke” program (a form of a Food Hub) for Southern Maryland.

Although primarily focused on providing specialty crops for the low-income, working poor, and unemployed populations, SMADC intends to learn from this approach to bring table crops to communities of all income levels while supporting specialty crop farmers. The Hub and Spoke Task Force proposed a three-year pilot program in which fresh, locally grown produce donations from farmers/gardeners are distributed to needy families in the five counties of Southern Maryland. While an important component of the project (a tax incentive) has yet to be enacted, the project moved ahead. The report is available on-line at www.smadc.com.

In partnership with a regional non-profit, Farming 4 Hunger (F4H), the project has worked with local farmers to bring over 4 million pounds of fresh produce to the hunger community since 2013. In 2014, SMADC funds (not through this grant) provided a refrigerated truck and warehouse space for F4H, thus enabling F4H to engage 29 specialty crop farmers from Southern Maryland, which has brought over \$300,000 dollars back to specialty crop farmers through food bank funds to date. Fresh produce from local farms was picked up by F4H, or grown onsite, and delivered to Spoke sites within 24-48 hours of harvest time. This model also works to keep the “food miles” within the region, and the produce fresher and more nourishing. Engaging new farmers in the region significantly enhanced the diversity, quality and freshness of farm products for the hunger community. In the 2014 and 2015 season, over 14 varieties of fresh produce went to Spoke sites throughout the region. Some of the distributions regularly included what was available (in season) July through November, such as: kale, collards, tomatoes, watermelon, green and red bell peppers, cabbage, sweet corn, potatoes, green beans, cantaloupe, apples, sweet potatoes, eggplant, squash, zucchini, and cucumbers.

In some cases, participating farmers doubled their economic benefit and, according to one farmer, most of this produce would otherwise have gone to waste.

The project has provided farmers with a sense of hope, knowing that there was a market for their “seconds, ugly tomatoes, surplus or dropped accounts by large wholesalers,” and provided an outlet for what would otherwise be considered wasted food in society. Farmers have indicated willingness to plant more produce, and more farmers have expressed interest in joining the project.

Farm Food Donation Tax Credit (financial incentive for farmers): A key component of the Hub and Spoke model is an economic incentive to reimburse farmers a portion of the cost of the harvest, packaging, and delivery. Emanating from the Hub and Spoke Task Force assessments, the Southern Maryland Delegation introduced a “Farm Food Donation Tax Credit Bill” in 2014, which passed in the Senate (46-0), but was not taken up by the House. The bill would have allowed “a qualified farm a credit, for tax years 2015 through 2017, of up to \$5,000 against the State income tax; providing that the credit is equal to 50% of the value of an eligible food donation or 75% of the value of donated certified organic produce; providing that, for a fiscal year, the total amount of tax credit certificates issued may not exceed \$250,000; reestablishing the Task Force to Study the Implementation of a Hub and Spoke Program in the Southern Maryland Region; etc.” It was envisioned as a pilot for the rest of the state.

The bill was re-introduced in January 2015 in both the House and the Senate under: “Income Tax Credit – Qualified Farms - Food Donation Pilot Program.” The initiative garnered interest from as far away as the Food Law and Policy Clinic at the Center for Health Law and Policy Innovation at Harvard Law School, who submitted a letter of support. The bill was not addressed during the 2015 winter legislative session.

Despite the lack of passage of the Maryland tax credit bill, SMADC still aims to help increase the number farms donating fresh produce to the hunger community through the Hub and Spoke program. Where it makes sense logistically, some farms donate directly to Spokes in their community. For example, as result of the Hub and Spoke program, a produce farm continues to donate several thousand pounds of fresh, organic produce direct to a food pantry in Charles County that serves up to 100 people in need a week. The partnership has gone so well that the pantry has not had to buy canned vegetables and fruits, thus providing its community fresher foods. The farm is a four season farm, which allows for produce to be delivered throughout the year. This farm, and farms who donate regularly, did not receive the benefit of the Maryland Tax Credit for Farm Food Donations, had it existed. SMADC will continue to work closely with Farming 4 Hunger, farmers, and the spoke sites to assist and enhance getting fresh produce to the hunger community.

Hub and Spoke Assessment Tool: In the fall of 2014, SMADC was contacted by the Johns Hopkins School of Public Health who was interested in developing additional tools to evaluate the Hub and Spoke program. A master’s candidate at the Johns Hopkins University Bloomberg School of Public Health did a capstone project on the program, and worked with SMADC over the course of her final semester to develop an assessment tool to measure the health impact of the Hub and Spoke program. The tool provided the program information beyond basic measures, such as the extent of unmet need for fresh food, knowledge, attitudes, and behaviors about fresh produce, and the program’s impact on social well-being and community engagement. The new assessment tool was administered during the 2015 season, and 115 surveys were collected during the season (July-October). The results of the survey are pending as of this grant reporting, but will be available over the winter of 2016. The survey is made to be modifiable for use in other communities. (Funds from this grant were not used in support of this effort, but information was used to shape the outcomes and accomplishments of this project.)

The Southern Maryland Food and Farm maps: In partnership with Johns Hopkins Center for a Livable Future, SMADC developed on-line, interactive farm and food maps. The maps can be used to understand food production and movement throughout the region, guide policy, and help determine areas of need and hunger (see www.smadc.com under Food/Farms/Nutrition). The maps educate the community about our food system to most efficiently utilize available foods, and identify how we can better distribute large quantities of food. (Funds from this grant were not used in support of this effort, but information was used to shape the outcomes and accomplishments of this project.)

*Note: Refer to the “Goals and Outcomes Achieved” section below for the Work Plan details.

☐ **If the overall scope of the project benefitted commodities other than specialty crops, indicate how project staff ensured that funds were used to solely enhance the competitiveness of specialty crops.**

Funds were solely used to enhance the competitiveness of specialty crops.

❑ Present the significant contributions and role of project partners in the project.

Since its inception in 2000, SMADC has worked extensively with key stakeholders on the topic of food distribution. We have strong connections with specialty crop producers, farmers markets, academic institutions, local food retailers, large-scale distributors, anti-hunger groups, and social services. We know that farming communities want to increase sales through better regional distribution, large-scale distributors want more local partnerships, and anti-hunger organizations have communicated the need for more fresh, local food.

SMADC Staff: The SMADC Executive Director, FarmLINK Director and Food Programs Coordinator worked together at SMADC on this grant initiative. The Specialty Crop grant was overseen by SMADC's Administrator, who tracks budgets and ensures that grant requirements are completed in a timely manner.

Agricultural Business Plan Consultant: SMADC hired a business consultant (ACDS) familiar with agricultural distribution systems throughout the mid-Atlantic region.

Agricultural Producers: SMADC has worked extensively with the farming community for fourteen years. We are familiar with the majority of specialty crop farms located in Southern Maryland, have a good rapport with operators, and are constantly exchanging information with this community.

Maryland Hub & Spoke Task Force: Staffed by SMADC, the Task Force met with many members of the community, including public health officials, University of Maryland educators, food banks, farmers, churches, pantries, Department of Corrections, and School Superintendents.

Anti-Hunger: Farming 4 Hunger (F4H) – Farming 4 Hunger is a non-profit dedicated to providing food for hungry families through local agriculture. Farming 4 Hunger has provided over 3 million pounds of farm-sourced produce to food banks since 2012. Through partnership with SMADC, in 2014 F4H partnered with 27 farms in Southern Maryland to aggregate and distribute food to the hunger community. As of 2015, F4H has partnered with 29 farms. F4H partners with the Maryland Food Bank to pay farmers for their products.

Johns Hopkins University Bloomberg School of Public Health: JHU developed an assessment tool for the Hub and Spoke project that was administered in the growing season of 2015. (separate funding)

Johns Hopkins Center for a Livable Future: CLF assisted SMADC in developing an interactive on-line Farms and Food Map to visualize food and farm systems in the region. (separate funding)

Southern Maryland Food Council: SMADC convened the Southern Maryland Food Council, which is made up of regional food stakeholders (anti-hunger, educators, gardeners, farmers, retail, citizens, etc.). The Council is focused on enhancing the sustainability and health of the economy and communities in the Southern Maryland through networking and project planning. The Food Council has brought members of the community together to identify areas of commonality and areas of need to attain mutual goals, including the Hub and Spoke, the Center, and the Farm and Food Maps. It

hosted two community networking events, and several follow-up discussion groups (separate funding).

Project Approach

Benchmark & Who	Steps/Achievements	Timeline
1. SMADC identifies needs, limitations, and assets of stakeholders	<p>1a. Identify county food needs (a regional food map)</p> <p>The Southern Maryland Food and Farm Map: SMADC developed on-line, interactive farm and food maps. The maps can be used to understand food production and movement throughout the region, guide policy, and help determine areas of need and hunger. The maps educate the community about our food system to most efficiently utilize available foods, and identify how we can better distribute large quantities of food. See www.smadc.com under Food/Farms/Nutrition. (Funds from this grant were not used in support of this effort, but information was used to shape the outcomes and accomplishments of this project.)</p> <p>1b. Conduct at least 2 information gathering town halls with farm businesses to determine interest and amount of food capable of growing, price points, aggregation/storage abilities, certifications, etc.</p> <p>SMADC hosted multiple public meetings on the Hub and Spoke Project during 2013-2014. 23 public gatherings between all 5 counties were held about the Center with farms and farm businesses during 2015. Approximately 150 individuals from the farm community were in attendance at these meetings.</p> <p>SMADC hosted a Buyer Grower Food Hub panel discussion for farm community in 2014. Approximately 50 individuals from the farm community came to this event.</p>	11/13-1/14

	<p>Hub and Spoke Program and Farming 4 Hunger held meeting with all fresh food donation organizations (held in 2014 and 2015). Approximately 25 anti-hunger organizations that participate in the fresh produce program were in attendance in 2014 and approximately 30 in 2015.</p> <p>1c. Identify at least 3 interested consumer outlets per county (institutions, restaurants, stores, markets, anti-hunger groups, etc.) to determine food type and volume preferences, transportation needs, GAP certification needs, and prices</p> <p>Charles county public schools (institution), Farming 4 Hunger (anti-hunger group), Herrington on the Bay (caterer)</p> <p>1d. Match food goals to farmer capabilities</p> <p>Researched farmer needs, transportation needs, Good Agricultural Practices (GAP), and volume potential with farms through this grant cycle.</p>	
2. SMADC contracts with outlets and farmers	<p>2a. Facilitate contracts with institutions and other outlets regarding purchasing capabilities</p> <p>No institution contracts have been developed yet as the Center is emerging.</p> <p>2b. Facilitate contracts with farmers for specific crops, amounts, and timing</p> <p>SMADC assisted Farming 4 Hunger with farmer contacts for the Hub and Spoke project, although no contracts were needed.</p> <p>2c. Determine education and services required by farmers to meet food distribution contracts (techniques for aggregation, packing, storing crops, and GAP certification)</p> <p>SMADC hosted a Buyer Grower Food Hub panel discussion for farm community in 2014. SMADC plans to hold crop planning meetings, and provide technical assistance (such as GAP training, for participating farms) through the Center.</p>	11/13-11/15
3. SMADC creates infrastructure & staffing plan	<p>3a. Determine necessary minimum infrastructure and technology for effective Food Hub (keep costs low)</p>	1/14-11/15

	<p>The Distribution Hub and Food Innovation Center would ideally be incorporated in a flex warehouse in conjunction with other Center Components, such as the meat processing facility. Based on currently identified demand, the following elements constitute the minimum development requirements for the Food Distribution within the Center are a flex cold storage warehouse design with sort, pack and repack capability. Unit size ~3,000 sq. feet. Initial concept tested may be within meat processing footprint.</p> <p>3b. Determine currently available infrastructure through networking (e.g., equipment for storage, processing, and transportation)</p> <p>NA</p> <p>3d. Identify the minimum staff necessary to run Hub Per the results in the business plan, once each component is fully up and running, the Distribution Hub, Food Innovation Center and Retail site have the potential for up to 20-30 jobs. The full Center has potential to create upwards of 62 jobs.</p>	
4. SMADC creates a financial plan balancing sales, infrastructure cost, and farmer payments (May require some consulting work if too complicated)	<p>4a. Determine total input costs (food costs, storage facility, processing equipment, transportation equipment/contracting, etc.) Completed Finances and Sustainability: The initial business plan intends that each for-profit component will be bid out as appropriate for a public and/or private enterprise to operate and lease. The business plan “pro-forma” shows hard and soft operating costs that will be repaid into a sinking fund, so that over 20 years, the initial hard and soft costs are repaid. The lease rates also covers management, administration, and Common Area Maintenance Fees. Once each component is running, the plan shows the Center management to be financially self-sustaining. The actual cost of the build-out will depend on the site/sites.</p> <p>4b. Cautiously calculate amount of potential revenue from sales Returns to the Community: Early business plan models show a potential \$3-5 million back to the farm community once each component is up and running.</p>	3/14-11/15
5. SMADC creates transportation & distribution plan	<p>5a. Identify most efficient pick-up plans (transport timing from farmer to possible storage/processing facility or direct to consumer outlet) The Hub and Spoke is one example of an efficient and</p>	9/14-11/15

	successful model for delivering fresh produce to the hunger community. The Hub and Spoke model utilizes a mobile drop, such that minimal infrastructure is needed and fresh produce food is distributed within 24-48 hours to the needy.	
6. SMADC creates expansion plan	6a. Identify other markets and farms for future Hub growth, with special consideration for expanded produce amount and variation (the expansion must always contribute to Food Hub and farmer success) The Center will have the means to aggregate and distribute food to large wholesale and retail accounts.	11/15

Some of the activities included in this section seem to reference lobbying activities. Expenses related to lobbying are unallowable under the SCBGP. Please verify that no SCBGP funds were utilized for this purpose.

As a 501-c-3 non-profit, SMADC/TCC staff are prohibited from lobbying.. No USDA funds or any funds were used for lobbying activities.

Since food hub projects often include non-specialty crop commodities, please indicate how you ensured that Specialty Crop Block Grant Program funds were used to solely enhance the competitiveness of specialty crops.

o Much reference is made to a meat packing plant, for example. SCBGP funds should not cover expenses related to the research of this facility. You also reference the livestock industry.

SMADC's Ag Business Park and Food Innovation Center initiative incorporates several components, including a food distribution center and food innovation center for table crops and produce. Specialty Crop Grant funds were only used to pay for staff time associated with specialty crops to include food hub research, meetings and conferences related to table crops and produce. Models explored included an innovative Hub and Spoke program procuring and distributing surplus produce for the hunger community, sales of produce to expand markets for farmers, and a commercial kitchen for value-added processing of produce.

No Specialty Crop Block Grant funds were used for any of the costs associated with the business plan or research on other components of the Center.

Goals and Outcomes Achieved

- ☐ **Describe the activities that were completed in order to achieve the performance goals and measurable outcomes identified in the approved application or subsequent amendments.**

The goal for the Maryland Specialty Crop Distribution Hub Project was to create a viable plan for a Distribution Food Hub in Southern Maryland including business, infrastructure, and management plans. During the grant period (and using additional funds) we completed a detailed, viable, and plan for an Agricultural Business Park and Food Innovation Center which is

1) acceptable to a professional business plan consultant familiar with agricultural businesses such as Food Hubs and 2) generally acceptable by community stakeholders such as farmers, markets/institutions, and consumers. We verified needs through public meetings and a widely distributed survey to stakeholder communities to quantify their confidence and understand their needs.

The plan incorporates multiple components including a Distribution Food Hub, ideally on one site, and a means to maintain financial viability by renting each component to entities aligned with SMADC's mission and goals for farm profitability and sustainability.

The plan was prepared in consultation with a professional business consultant (ACDS) and has been vetted widely with the community through 23 public meetings.

In addition, in 2015 SMADC surveyed the community to prioritize components of the Center. Results indicated that food distribution was a top priority, surpassed only by the need for a regional meat processing facility.

SMADC held 23 public meetings in all five counties of Southern Maryland to discuss and engage that community on the Center.

As of December 14, 2015, a survey was sent to all producers and the general public in Southern Maryland, including wholesale and retail producers to help prioritize the components of the business plan. 700 surveys were sent out. 425 directly via various MailChimp campaigns and approximately 275 hard copies made available at all of our public meetings. The survey had been completed by 104 participants, all of whom endorsed the concept. Some comments from survey participants on the Distribution Center include the following: "This will open more opportunities for the already established farms" and "This is such a great idea, it is very much needed in the area, I am so happy to see this coming to our area, we need to do more to support local farmers and this will allow a centralized location to provide resources for both farmers, producers, and consumers. There are people who would rather buy local food, if was accessible but just like for restaurants, it hard to get your hands on. Thank you for all of your hard work to get this project off the ground!" The survey was located on our website, provided as a link and available at all public meetings as a paper survey.

The Distribution Food Hub is envisioned to help our farmers and food businesses gain entrance into markets they are not currently tapping and facilitate better access to the \$26 billion food market in the Washington DC-Baltimore metro region. It will efficiently aggregate and distribute local farm foods to underserved markets, and assist farmers by delivering to buyers, thereby decreasing transportation costs and time.

If funds permit, a Food Innovation Center will be developed at the same time to provide processing services for specialty crops. As envisioned, the Center is envisioned to host a retail site and provide business and on-the-ground training for new farmers and start-ups using locally produced specialty crops.

Some of the Elements of the Distribution Food Hub envisioned include:

- Distribution to retail and wholesale buyers including restaurants, institutions, grocers,

- wholesalers throughout the Baltimore-DC and local area
- Grower aggregation and packing area that meets Good Agricultural Practices (GAP) and ISO standards
- “Surplus” food extended to food innovation center (below) and regional non-profits for the hunger community
- Utilize existing infrastructure where practical and possible (e.g. structures that are available regionally or “re-purposing” those on-site)
- Utilize existing trucks moving throughout the region and state for pick-up and delivery (e.g.: distributors, caterers, restaurants, non-profits, etc.)
- Contract production, as appropriate, from incubator clients and new farmer incubation program moving products from Center clients as appropriate
- Market to build on established programs such as *So. Maryland, So Good*
- Management by Center or leased to farmer organizations, private sector, and/or organizations with supportive missions
- Commitment to providing farmers a fair price and/or return for their food

Some of the Elements of the Food Innovation Center envisioned include:

- Operates as a revenue center for regional farms and on-site farms
- Capacity for both U.S. Food and Drug Administration (FDA) and U.S. Department of Agriculture (USDA) processing
- Community areas and culinary training opportunities
- Training and process areas
- Office space for training and facility management
- Food Safety training and value-added processing courses offered in partnership with MDA, UME, and others
- Operation of an outdoor farmers’ market (there is a need to move a local Amish farmers market from its current site, the Center could include that market depending on site location)
- Indoor retail space managed by Center or leased to farmers, private sector, and/or organizations with supportive missions
- Market to contract production, as appropriate, from incubator clients
- Marketing and training to build on established programs such as *So. Maryland, So Good*
- Managed by Center or leased to farmer organization, private sector, and/or organizations with supportive missions

Strengthening the Region’s Multi-Cultural Farm Community: Southern Maryland spans from the urban counties of Prince George’s and Anne Arundel to the more rural counties of Calvert, Charles, and St. Mary’s. The needs differ vastly from the urban table crop farmers in the north to the those of the Amish, Mennonite and English farmers in the south. SMADC is dedicated to helping each community meet their needs.

Management and organization: Each component would be managed by Center or leased to farmer organizations, and/or public or private organizations with supportive missions that align with SMADC’s strategic goals.

As envisioned, the Center concept is a response to transitional pressures in the regional agricultural economy that challenge both the financial sustainability of traditional agricultural operations as well as the attraction of new farmers and emerging agricultural sectors. These challenges are recognized to be emerging at a time when the market area is undergoing significant growth in terms of both purchasing power and population.

- ☐ **If outcome measures were long term, summarize the progress that has been made towards achievement.**

NA

- ☐ **Provide a comparison of actual accomplishments with the goals established for the reporting period.**

- ☐ **Clearly convey completion of achieving outcomes by illustrating baseline data that has been gathered to date and showing the progress toward achieving set targets.**

- Center plan developed.
- Hub and Spoke Model for mobile food distribution enhanced and implemented engaging 29 farms, and over 3 million pounds of specialty crops grown and distributed over 2 years.
- Farm and Foods Maps created and published.
- 23 public meetings and 103 respondents to public survey.

Beneficiaries

- ☐ **Provide a description of the groups and other operations that benefited from the completion of this project's accomplishments.**

Those listed in the Partners section above are the groups and other operations that have and will benefit from the Food Hub project's accomplishments.

This includes approximately 112 produce farms, as identified through SMADC and the John Hopkins Center for a Livable Future.

- ☐ **Clearly state the number of beneficiaries affected by the project's accomplishments and/or the potential economic impact of the project.**

The benefits of the Center are intended to help the farmers and the community. The Center will increase the region's capacity to meet consumer demand for locally produced specialty crops and create new jobs for the region.

The Center will make it more efficient for farmers to aggregate and distribute local produce, and help our farmers and food businesses gain better access to the \$26 billion food market in the DC-Baltimore metro region. Ideally, creating a centrally located site (or series of sites) with these

multiple uses will allow businesses to share assets, personnel, training, cross marketing, and more.

Lessons Learned

- ☐ Offer insights into the lessons learned by the project staff as a result of completing this project. This section is meant to illustrate the positive and negative results and conclusions for the project.

See section on legislative action needed. This was unanticipated and has added significant time to develop the project.

- ☐ Provide unexpected outcomes or results that were an effect of implementing this project.

Clarification of terminology- Food Hub:

As this project evolved, we realized we needed to clarify our use of specific terms as well as specific projects. Our use of the term “Food Hub” had been intermingled with the “Hub and Spoke” project, which caused some confusion to all. We now use the term “Hub and Spoke” project to refer to our work with the community and specifically Farming 4 Hunger to bring fresh farm food to the hunger community, while enhancing profitability for farmers. We are now describing the “Food Hub” as the “Agricultural Business Park and Food Innovation Center “(The “Center”)", although they are really synonymous. We are still on track to boost market impact of farm products by targeting products to meet market needs through communication of unique community food requirements.

- ☐ If goals or outcome measures were not achieved, identify and share the lessons learned to help others expedite problem-solving.

Be persistent and engage the community! We held a number of public meetings for farmers, elected officials, and the public and we found that was very important and beneficial to the development of the business plan. The survey data (103 responses) was also very helpful in prioritizing which Center components the community wanted prioritized first and helped us understand the needs of the community as they stand today. We are excited to see the emergence of the new and young famers, at least half of which are in the livestock industry; which did not exist two years ago in the region. As an organization, SMADC is able to be nimble and innovative in order to respond to the changes and needs that emerge from the community, which has also been helpful in bringing this concept to fruition.

- ☐ Lessons learned should draw on positive experiences (i.e., good ideas that improve project efficiency or save money) and negative experiences (i.e., lessons learned when goals or objectives did not go according to plan).

The entire process has brought forth considerable interest and good will from the community, although the unanticipated legal and legislative requirements are still being resolved.

When considering a project like this, it is important to look beyond the needs of today, and into the future of food and farming. For the Center to be successful, the needs of new farmers are important to keep in mind. The Centers components provide an inclusive setting for new farmers to learn, process, aggregate and distribute specialty crops which will help new farmers find markets when starting out. Working to build the capacity of farmers over time is important to keep in mind with a project like this.

Contact Person

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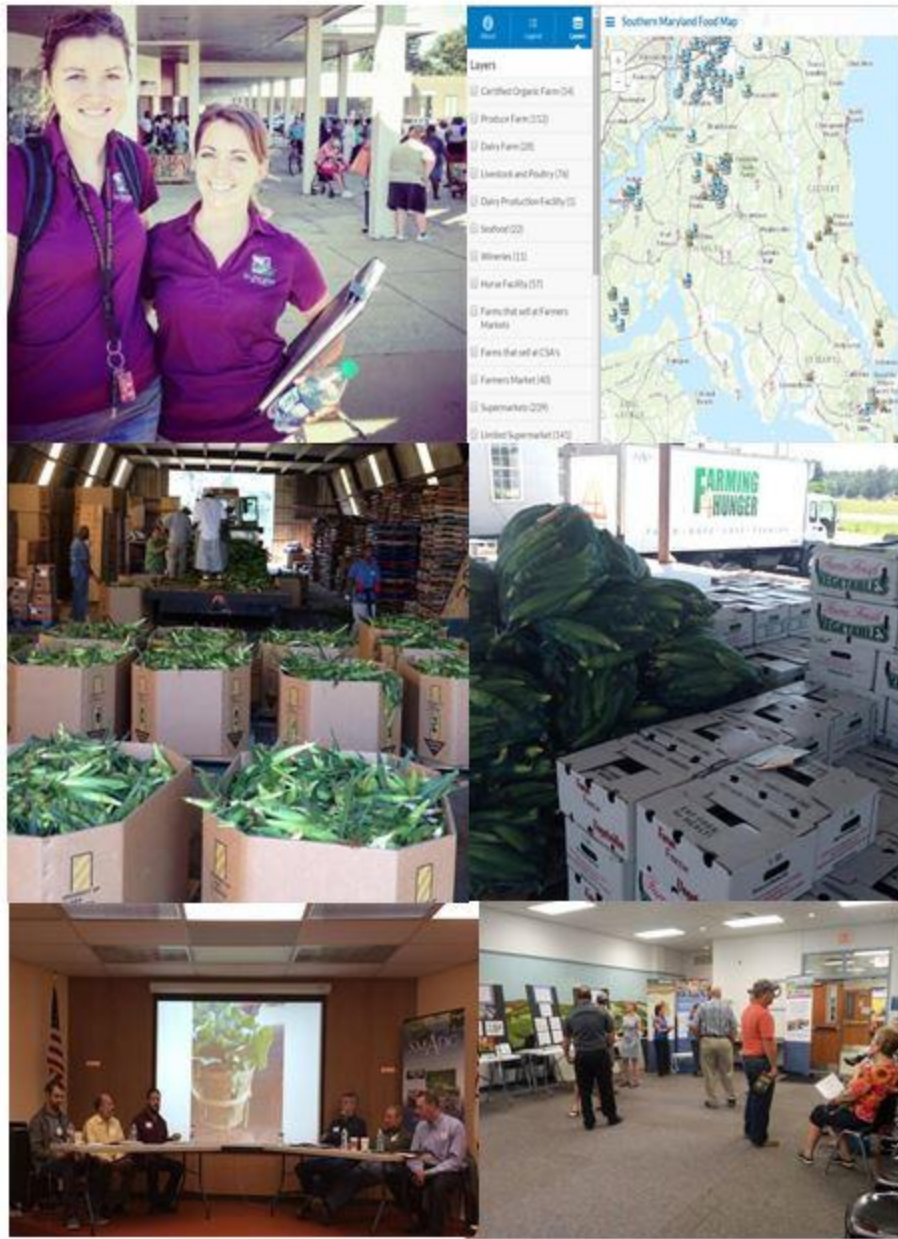
Additional Information

☐ Provide additional information available i.e. publications, websites, photographs. Incorporate additional information into the report as no PDF's of documentation will be accepted.

Highlights and Articles of interest during grant period (though November 13, 2015)

- Initial business plan elements drafted
- SB 909 passed
- Selection criteria developed for site
- Two EOI (Expression of Interest) publicly issued to solicit site/sites
- EOI committee identified
- 23 public meetings / open houses have been held regarding the Center
- Community Survey issued on-line and in-print (103 respondents in 2015)
- Webpage created to administer surveys, post deadline information, FAQ's, and allow for questions from community members and farmers. Website link:
www.smadc.com/programs/agcenter.html
- Researched and published two "Existing and Emerging Food Hubs in Maryland" report (2014 edition and 2015 edition).
http://smadc.com/food_farms_nutr/mdfoodhubs.html
- Hosted the Maryland Region Existing and Emerging Food Hub workshop with the Wallace Center. Article: <http://smadc.com/blog/food-hub-workshop-yields-a-bountiful-crop-of-ideas/>
- Food Hubs Sprouting up in Maryland, Greg Bowen, SMADC staff post:
<http://smadc.com/blog/food-hubs-are-sprouting-up-in-maryland/>
- Hosted a Southern Maryland Buyer Grower Workshop with food hub panel discussion. 65 farmers and retailers in attendance. <http://smadc.com/blog/we-want-our-food-money-back/>
- Measuring the local food movement, staff blog post: <http://smadc.com/blog/2012-ag-census-measuring-the-local-food-movement/>
- The Southern Maryland Food and Farm Map: SMADC developed on-line, interactive farm and food maps. The maps educate the community about our food system to most

- efficiently utilize available foods, and identify how we can better distribute large quantities of food. http://smadc.com/food_farms_nutr/map.html
- Wednesday, September 3, 2014 “Hub and Spoke program having successful first season” <http://www.somdnews.com/article/20140903/NEWS/140909861/1044/hub-and-spoke-program-having-successful-first-season&template=southernMaryland>
 - Monday September 29, 2014 “Sowing Seeds” Presented at the Maryland Hunger Conference, Dr. Christine Bergmark and Priscilla Wentworth. The presentation provides a current update of the entire Hub and Spoke and Food Hub initiative. [http://smadc.com/food_farms_nutr/Sowing%20Seeds%20SMADC%20F4H%20CB%20PW%20September%2028%202014\(optimized\).pdf](http://smadc.com/food_farms_nutr/Sowing%20Seeds%20SMADC%20F4H%20CB%20PW%20September%2028%202014(optimized).pdf)
 - It’s Time to Look at a Southern Maryland Food Hub, Staff blog: <http://smadc.com/blog/it-is-time-to-look-at-a-southern-maryland-food-hub/>
 - Hub and Spoke program website launched, summer 2014. http://smadc.com/food_farms_nutr/hubspoke.html
 - The first and second regional “Foodways Community Networking” Event in Spring of 2014 and Spring of 2015. The 2015 event featured the Center.
 - SMADC staff attended the Chesapeake Food Policy Leadership Institute in Baltimore hosted by Johns Hopkins Center for a Livable Future.
 - Food Hubs increase Prosperity: <http://smadc.com/blog/food-hubs-increase-farm-prosperity/>
 - Proposal Unveiled for Regional Ag Park: <http://www.thebaynet.com/articles/0515/proposal-unveiled-for-regional-ag-park.html>
 - Scaling Up to Meet Demand for Local Food in Maryland, Staff blog: <http://smadc.com/blog/scaling-up-to-meet-the-demand-for-local-food-in-maryland/>



Top Left: Karyn Owens Student Intern, SMADC (left) and Priscilla Wentworth (right) Food Programs Coordinator, SMADC administering a survey at a fresh food distribution in Lexington Park, Maryland summer 2015.

Top Right: Southern Maryland Food and Farms Map. Interactive public map detailing the food system in the region.

Mid Left: Specialty crops being packaged for distribution.

Mid Right: The Farming 4 Hunger distribution truck in action.

Bottom Left: Panel speakers from SMADC's Buyer Grower farmer event in 2014.

Bottom Right: Executive Christine Bergmark, speaks with farmers about the Center at one of SMADC's public meetings in 2015.

A copy of the 2015 survey distributed (online and offline) to the community.



Ag. Business Park & Food Innovation Center

The Southern Maryland Agricultural Development Commission (SMADC) wants your input!

Name *

First

Last

Are you a *

☐ Farmer

☐ Wholesaler

☐ Retailer

☐ Consumer

☐ Government

☐ Elected Official

☐ Other

Age *

☒ Under 30

☐ 31-39

☐ 40-49

☐ 50-59

☐ 60-69

☐ 70 or older

County *

Prioritize the components: Please number the eight components of the proposed Ag and Food Center in the order in which you would like to see them developed. Check number 1 by the component you feel is most important, number 2 by component that is your second priority, and so on.

	1	2	3	4	5	6	7	8
Distribution Center (Aggregation and distribution of local farm food)	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7	<input type="radio"/> 8
Meat Processing Facility (Slaughter & processing of local livestock/ meat)	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7	<input type="radio"/> 8
Aquaculture processing (Processing and/or packing of local seafood)	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7	<input type="radio"/> 8
New Farmer Incubation (3-5 acre parcels for new farmers to start businesses for 3 yrs.)	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7	<input type="radio"/> 8
Food Innovation Center (kitchens for start-up businesses to commercially process food sourced from local farms)	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7	<input type="radio"/> 8
Outdoor Seasonal Farmers Market	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7	<input type="radio"/> 8
Indoor year-round market with deli or cafe	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7	<input type="radio"/> 8
Warehouse space (for locally produced food)	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> 6	<input type="radio"/> 7	<input type="radio"/> 8

If there is another component that you feel we should consider please list it here.

FINAL REPORT

Project Title: Monitoring and Management of Stink Bugs in Processing Sweet Corn

Project Summary. Insect injury on ears causes discolored kernels after blanching that can significantly reduce the grade and marketability of processing sweet corn. Potential insects that can cause kernel injury include sap beetles, stink bugs and lepidopteran larvae, particularly the corn earworm. Physiological disorders, not related to insect feeding, can also cause blemishes on kernels, resulting in reduced grade of the final product. Increased populations of native brown stink bugs (BSB), coupled with the introduction of the invasive brown marmorated stink bug (BMSB), have raised concerns about their role in reducing sweet corn ear quality. A 2012 SCBGP project funded by MDA generated information on the damage potential and seasonal population dynamics of stink bugs in sweet corn fields; however, their impact on the quality of the processed product is still unresolved. In this project, we sampled 87 sweet corn fields to quantify the abundance and spatial patterns of specific insect populations as possible causes of defective kernels. Based on this formation, recommendations were made to minimize grading reductions by modifying the aerial applications and segregating truckloads of harvested ears from infested portions of fields. We also quantified the ear damage by specific pest species in each field at harvest time and linked this information with the raw product quality data collected in the cannery. Results indicate that sap beetles and blemished kernels were the major causes of defective kernels. Working with quality control personnel, we developed a quantitative rating system to estimate the percentage of defective kernels entering the processing plant. Using this monitoring system, a defective kernel levels exceeding 1% indicated the potential for grade reductions in the final product. When this occurs, quality control personnel can now modify the parameters of the optical sorting equipment for more liberal removal of defective kernels. Alternatively, a decision can also be made to change the type of processed product to one that is less likely to be graded substandard. Altogether, project results has resulted in a better understanding of the quality control issues and will lead to a more efficient monitoring program and cost-effective, environmentally-acceptable management strategy that targets the appropriate pest problems.

Project Approach. Two summer technicians were recruited and trained to conduct field visits to determine the insect pests involved, infestations levels, and spatial patterns of infestations within sweet corn fields. They were assigned a University vehicle for transportation to and from 93 fields that were distributed throughout the Delmarva Peninsula. After all fields were planted, the cannery field supervisor provided GPS coordinates of each field and the technicians viewed each field on Google Earth to characterize the percentage of field perimeter adjacent to woodlots, other crop fields, or open non-cropped areas. Hard copy images of each field location were used to plan sampling routes relative to different adjacent habitats. Further revision of adjacent habitats was determined later by ground observations.

Field visits commenced in mid-June and focused each week on fields that had tasseled, just prior to silking but before the first application was applied. Subsequent visits were made following insecticide applications and just prior to harvest. The cannery provided daily email updates of all control actions to the project leader, who then communicated with the technicians to schedule field visits according to safe re-entry times. Fields were inspected following

insecticide applications to evaluate control effectiveness and determine if insect infestations continued to build up. Of particular concern was whether sap beetles and stink bugs would invade fields after the last application, which normally occurred 7 to 10 days prior to harvest. For this reason, field visits were scheduled after the last application.

Each field inspection involved transects of samples taken from at least four sides of the field adjacent to different habitats. If the field was bordered by a woodlot or an early host plant such as small grains (expected sources of insect infestation), plants were always examined at the field edge next to these habitats. At each field side, the transect sampling consisted of visual counts of sap beetles and stink bugs on ten consecutive plants on the outer row, and on rows at 10, 30 and 100 feet into the field. If consistent numbers of insect pests were found, additional sets of plants were inspected at sites farther into the field interior to determine the extent of the infestation. Data were reported on the number of sap beetles and stink bugs per 10 plants at different sampling sites, observations of unusual injury by other pests, and the plant growth stage. An average of 2.4 sampling visits (range 1-5) per field were made in 87 fields over the growing season, during which a total of 940 sampling sites were inspected across at least four transects. Field inspection reports were emailed daily to the project leader, who summarized the data and made recommendations that were then emailed to cannery field personnel. The information was used to modify insecticide schedules and choices of insecticide products to provide effective control of the specific insect pests present, and also to identify high risk fields that could potentially cause reductions in grade when harvested.

Another monitoring approach was the use of insect traps to monitor lepidopteran insect populations that impact sweet corn production. Blacklight and pheromone traps were setup in early May at two research farms (Queenstown and Salisbury) on the Eastern Shore and captures of European corn borer and corn earworm were recorded three times weekly. Records of real-time moth captures from a trapping network operated by the University of Delaware were also obtained online to indicate insect population pressure for scheduling insecticide applications.

Additional data was recorded at the processing plant personnel, who sampled harvested ears from each field to record the level and specific causes of kernel injury. Normally, the cannery operated from 6 AM to 12 midnight and processed corn from 1 to 3 fields during each day shift, depending on the field acreage. Truckloads of ears unloaded into the receiving hopper were identified by field, and a random sample of 100 ears was removed for examination. Each ear was husked and rated for the amount of kernel damage on the tip, upper and lower portion of the ears. The suspected pests (lepidopteran larvae, sap beetle larvae, or stink bug) causing the damage was also recorded. The amount of kernel damage caused by corn earworm or fall armyworm was estimated visually as the cm² of kernel surface area consumed. For sap beetle or stink bug injury, data were recorded on the number of kernels damaged and the location of damage. Blemished kernels were also recorded separately if they did not appear to be caused by insect feeding.

The quality of the ears entering the cannery was also tracked every two hours by sampling 25 ears removed from the processing line after the mechanical huskers. Two quality control inspectors stationed at the cannery were trained to examine the ears and record the number of defective kernels. Data were also recorded on the number of kernel rows per ear and number of kernels per row. This information was used to calculate the percentage of defective kernels which provided an indicator metric for predicting the potential impact on the grade of the final product.

Goals and Outcomes Achieved. Insect pest populations. Pooled over all samples, 27.6, 73.6 and 10.3% of the fields had varying infestation levels of sap beetles, stink bugs (exclusively BSB), and lepidopteran larvae (exclusively corn earworm), respectively. Counts of sap beetles and stink bugs on the outer 40 rows averaged 0.07 (range 0-0.8) and 0.34 (range 0-1.18) per ten plants, respectively. There was no evidence of corn borer feeding activity in any field, and only one late-planted field near Middletown, DE had confirmed sighting of the brown marmorated stink bugs at the field edge next to soybean fields.

Overall infestations of insect pests were considered very low for several reasons. First, European corn borer populations have been drastically reduced over the past decade due to the high adoption of Bt field corn on the Delmarva Peninsula. As of 2013, 83-93% of the corn acreage is planted in Bt hybrids, which has completely eliminated reproduction of corn borers in their primary host plant. Unlike corn earworm, corn borer populations are not recruited later in the summer by migrant moths from the South. Blacklight trap records collected before and after the commercial use of Bt hybrids show significant declines in corn borer moth activity. Average daily catches of corn borer moths in traps operating in Delaware and the Eastern Shore of Maryland have declined by 72-77% since the introduction of Bt corn hybrids in 1996 (**Figs 1 and 2**). Similar patterns in corn earworm moth activity are also evident by trap records that show a 60-61% decline during the past 18 years (**Figs 1 and 2**). These trends in moth activity provide strong evidence that populations of both sweet corn pests are significantly lower as a result of the regional suppression exerted by the Bt field corn acreage. Earworm moth flights in 2014 were well below the long-term historical records (down 50% compared to yearly records since 1997; down 80% compared to yearly records prior to 1997). This insect overwinters successfully as pupae in the soil on the Delmarva Peninsula; however, the frozen soil resulting from the cold winter of 2013-14 eliminated the overwintered population. A peak of earworm moth emergence from the overwintered pupae normally occurs in mid-June but was completely absent in 2014. The same winter conditions adversely affected the overwintering populations of sap beetles and stink bugs, resulting in lower than normal field infestations.

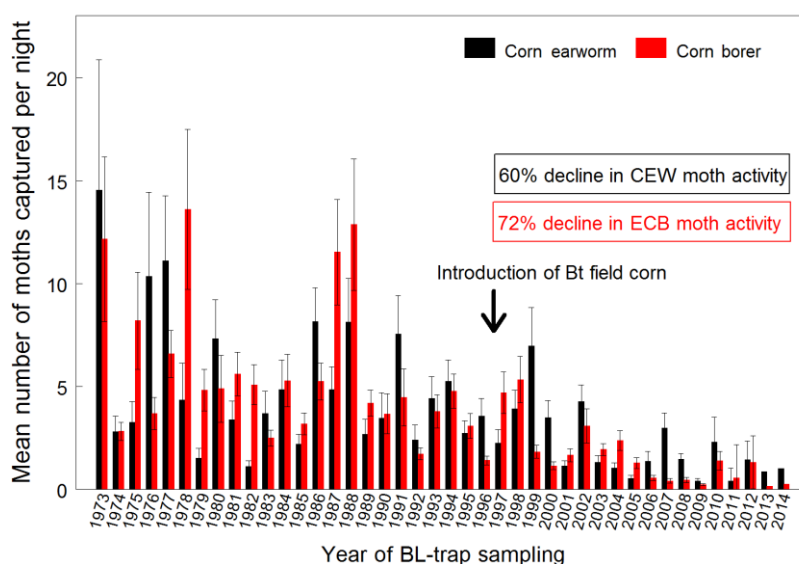


Figure 1. Mean (\pm SE) number of corn earworm and European corn borer moths captured in blacklight traps per night during 1973 to 2014 from the mid to lower Eastern Shore of Maryland.

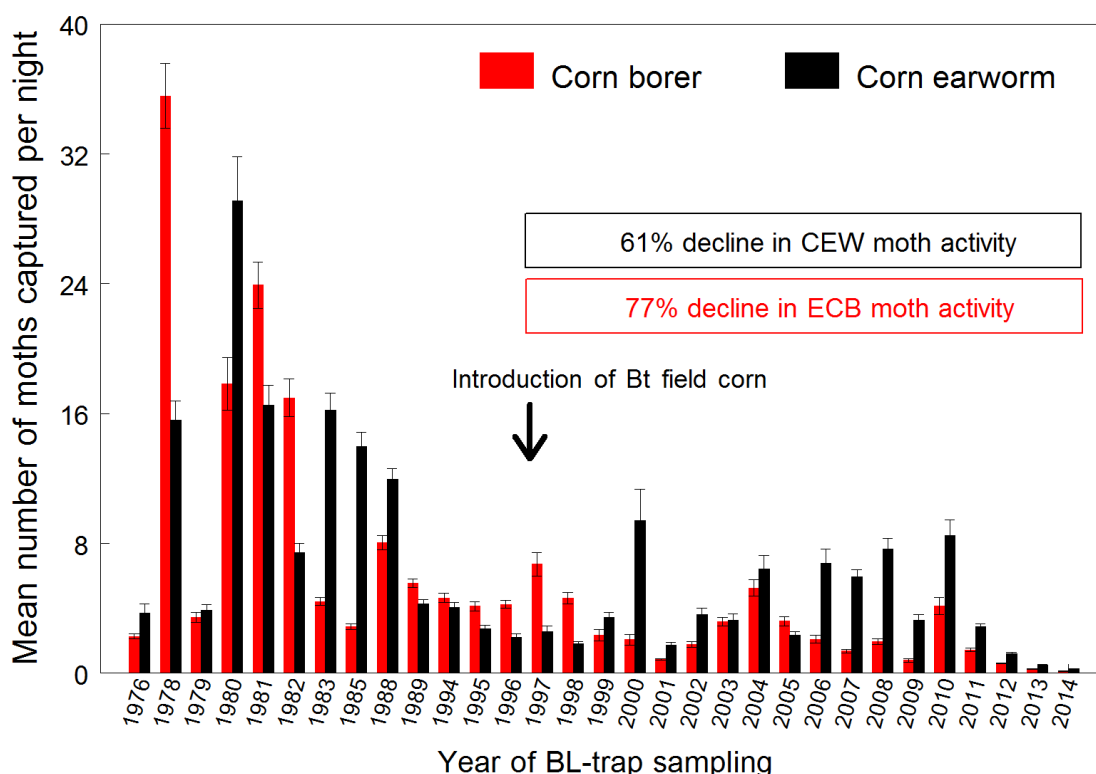


Figure 2. Mean (\pm SE) number of corn earworm and European corn borer moths captured in blacklight traps per night during 1976 to 2014 from the Kent and Sussex Counties of Delaware.

Field infestation patterns. Sap beetle infestations were aggregated in the outer rows of the field margins. Of the total number of beetles counted, 74.2% were observed within the first 10 feet, while 14.5 and 11.3% were observed at 30 and 100 feet from the edge of fields, respectively. Adult beetles moved into sweet corn fields from adjacent habitats but there was no consistent trend showing preferences for a particular type of habitat. Highest densities were recorded along field edges next to corn, soybean, woodlots, and hedgerows. Sap beetle counts were significantly lower during field visits conducted prior to July 15 and this could be attributed to lower levels of worm damage which is known to attract sap beetles. The highest counts were recorded during field visits from July 15 through August 1.

Brown stink bug infestations exhibited an even stronger aggregation pattern along the field margins. Of the total number of stink bugs counted, 86.9% were observed within the first 10 feet, while 10.0 and 3.1% were observed at 30 and 100 feet from the field edge, respectively. Stink bug densities also showed a definite pattern of invasion associated with certain types of adjacent habitats (**Fig 3**). Counts were highest (0.74 per 10 plants) along field margins next to small grains fields, followed by soybean (0.41 per 10 plants) and woodlots (0.20 per 10 plants). Brown stink bugs were more abundant (0.43 per 10 plants) during the early field visits prior to July 15 when small grains were mature or being harvested. These insects are known to feed on the flowering heads of wheat and other small grains and then emigrate from these early hosts when plants start to ripen.

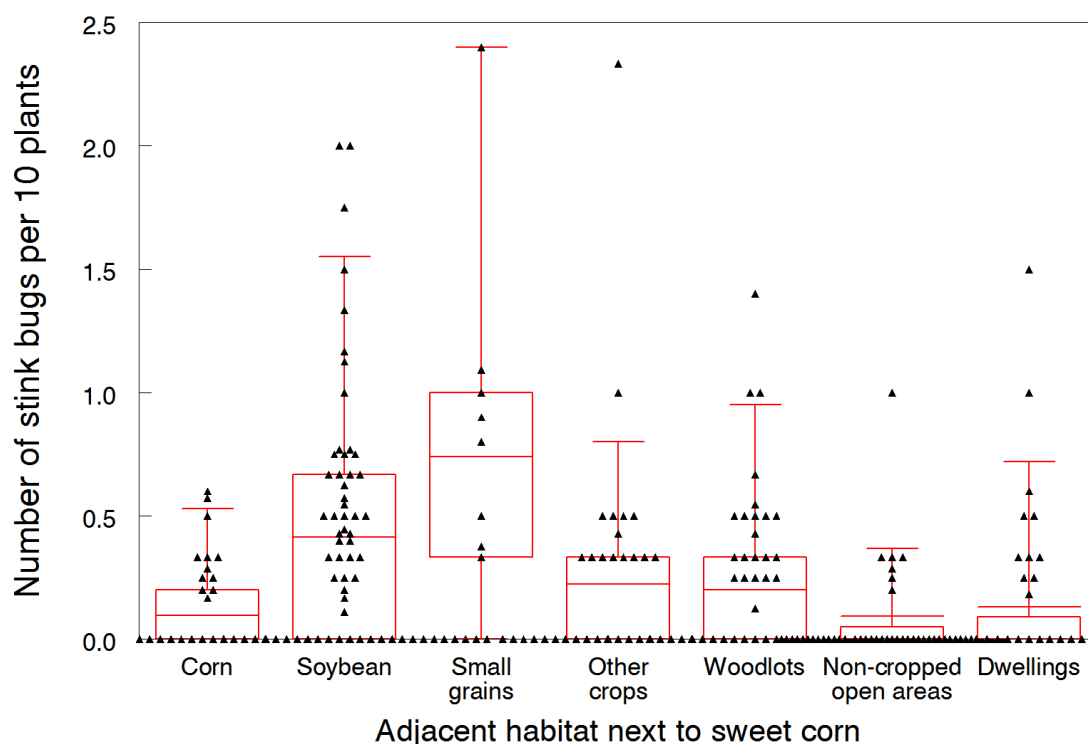


Figure 3. Box graph of the number of native stink bugs per 10 plants recorded in the border rows within 100 feet from the edge of sweet corn fields. Triangles represent the individual data at different sampling sites. The box contains 50% of the data, the horizontal line within the box is the mean, and the upper limit depicts the range.

Several management implications for sweet corn fields can be drawn from the spatial and temporal patterns of infestations. The results clearly indicate sap beetle and stink bug infestations are mostly concentrated on the outer margins of fields, suggesting that treatment decisions can be made by limiting monitoring to these areas, usually up to 100 feet into the field. Secondly, field edges adjacent to small grains, soybeans, and woodlots should be prioritized for monitoring over other adjacent habitats. Thirdly, aerial application of insecticides over the entire field may not be required if stink bugs and sap beetles are the only targets for control. However, this may not be operationally feasible because many sweet corn fields are also treated for corn earworm infestations, which are usually distributed throughout the field. Still, it may be possible to modify the aerial application, such as applying a second pass to achieve more complete spray coverage where sap beetles and stink bugs aggregate. Finally, knowledge of the spatial distribution of these insects can be useful in directing where to assess ear damage just prior to harvesting. If defective kernel levels are high enough to cause grading problems, it might be possible to segregate truckloads of ears from infested portions of fields to be processed differently at the cannery to minimize grading reductions.

Ear damage and defective kernel assessments. Additional data were recorded at the cannery to quantify the kernel damage caused by specific pests and determine the level of defective kernels that triggers grading problems. Samples of 100 ears from 53 fields were examined directly from truckloads, while samples of 25 ears from 84 fields were removed every two hours from the processing line after the mechanical huskers and examined for defective kernels. Kernel damage caused by specific pests was more clearly discernible by husking ears taken directly from truckloads before they entered the processing line. The overall percentage of

ears with kernel injury averaged 11.1% (range 0-39.5%), and the average number of defective kernels was 0.77 per ear (range 0-3.9). This level of injury represented approximately 0.10% of the total kernels based on an average of 738 kernels per ear.

Worm damage was almost entirely due to the corn earworm. The percentage of ears with feeding injury was very low, averaging 0.86% (range 0-9.1%), which agreed with trap records of earworm moth activity and observations from field visits. The kernel area consumed per ear averaged 0.03 cm² (range 0-0.5 cm²) and was almost entirely confined to the ear tip. This low level of earworm damage had minimal impact on the quality of the final product because the cutters probably removed very few damaged kernels at the ear tip.

Kernel injury caused by sap beetles and stink bugs was difficult to distinguish and best determined by examining husked ears prior to entering the cannery. Injury by adult sap beetles is confined exclusively to the ear tip and characterized by kernels appearing to be ripped apart, usually completely consumed, and leaving only the pericarp. Adults cannot penetrate beyond the ear tip if they are able to invade the ear. Generally, they rarely enter the ear tip of ears with tight tip coverage. Instead, larvae hatching from eggs laid on silks can disperse into the ear and damage kernels well beyond the ear tip. Larval injury is characterized by partially collapsed kernels, often discolored on the side of the kernel where the larva has entered, and associated with fine dust-like deposits (fecal material). The percentage of ears with sap beetle injury averaged 3.21% and ranged from 0 to 40% for the 53 fields sampled from truckloads. The average number of defective kernels attributed to sap beetle feeding was only 0.23 per ear (range 0-2.8). Samples were also taken from different truckloads from the same field to determine if the first loads had more ear damage than subsequent loads, assuming that the first load contained ears harvested from the outside rows with presumably more insect activity. All measurements of ear and kernel injury, except for corn earworm, were consistently higher in samples from the first truckload. For example, 13.5% (± 1.7 SE) of ears from the first load were damaged with 0.86 (± 0.14 SE) defective kernels per ear, compared to 9.3% (± 1.0 SE) damaged ears and 0.62 (± 0.07 SE) defective kernels per ear from subsequent loads. These results agree with spatial distribution of the sap beetles and stink bugs and further suggest that truckloads might be segregated and processed differently in order to minimize grading problems.

Similar levels of injury were attributed to stink bug feeding. The percentage of ears with stink bug injury averaged 3.7% (range 0-56%), of which the number of defective kernels was 0.17 (range 0-2.2). Stink bugs caused similar injury to kernels but there was no presence of fecal material because these insects insert their feeding stylets through the husk leaves from the outside. Injured kernels show sunken or collapsed area due to internal tissue removal, usually on the top crown of the kernel, and associated with a chalky white pericarp surrounded by darker yellow or brownish discolored margins.

Unfortunately, both types of insect injury to kernels have somewhat similar appearance to blemished kernels which are thought to be caused by physiological stresses. Blemished kernels were characterized by brown discolored blotches on the crown of the kernels, irregularly shaped with darker outer margins, and usually several affected kernels are clumped together. Blemishes are usually not sunken and appear to be originating from endosperm tissue below the pericarp. The incidence of blemished kernels was higher, averaging 7.23% (range 0 to 33%) of the ears affected and 0.33 (range 0-2.5) blemished kernels per ear.

The quality of ears entering the cannery was also tracked every two hours to record the percentage of damage ears and defective kernels. These assessments did not qualify kernel injury by specific causes but were used as an indicator metric for predicting the potential impact on the

grade of the final product. **Figs. 4 and 5** present the mean (\pm SE) percentage of ears damaged and defective kernels per field averaged over all samples taken while ears from each field were processed. Averaged over all fields, 15.1% (range 0-49%) of the ears showed some level of kernel injury, with a mean 0.12% (range 0-0.49%) of the kernels recorded as defective.

According to cannery quality control, defective kernel levels exceeding 1% indicate the potential for grade reductions in the final product. When this occurs, quality control personnel can modify the parameters of the optical sorting equipment for more liberal removal of defective kernels. Alternatively, a decision can be made to change the type of processed product to one that is less likely to be graded substandard. Defective kernel levels in all fields averaged below 1%, resulting in excellent quality of the processed product throughout the entire season. Only one 2-hour sample from field 16 recorded on July 30 exceeded the 1% level.

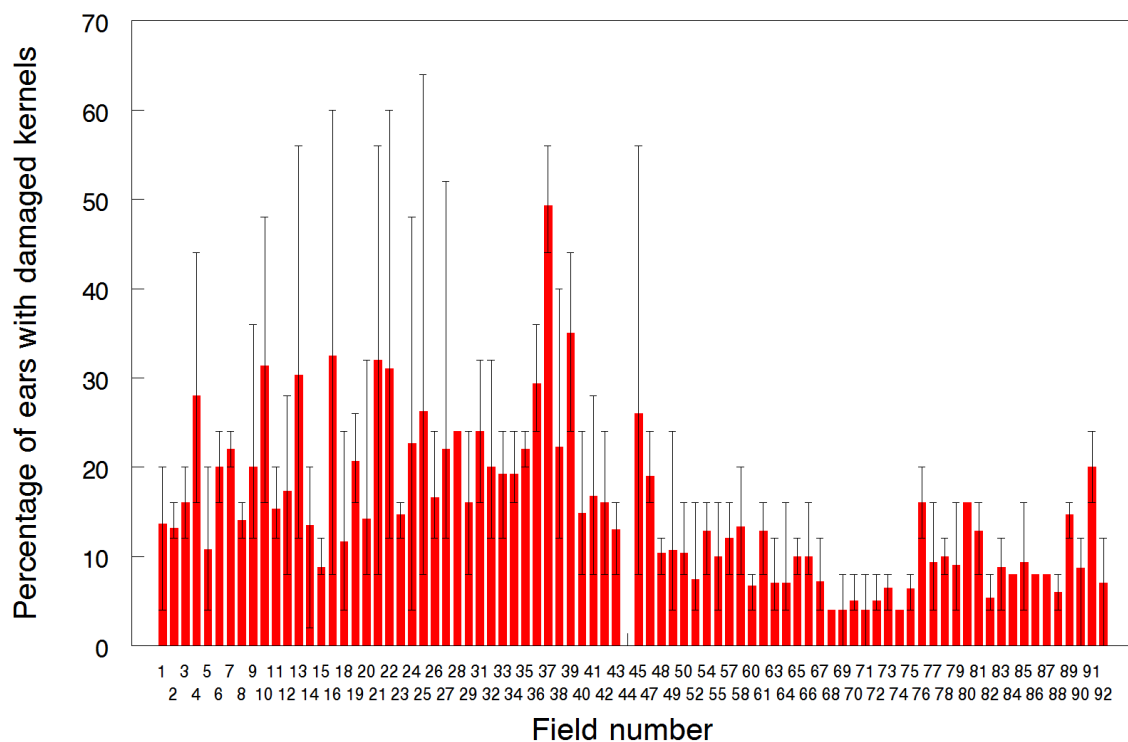


Figure 4. Mean (\pm SE) percentage of sweet corn ears with damaged kernels caused by insects or other non-insect related factors. Data for each field were collected every two hours from ears entering the cannery while the ears were processed.

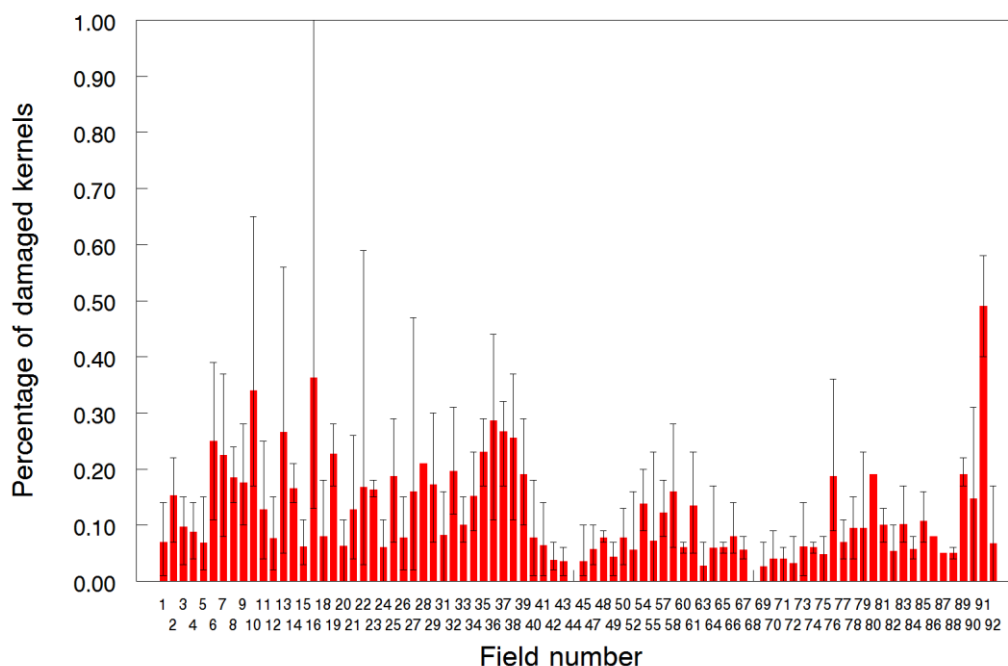


Figure 5. Mean (\pm SE) percentage of defective kernels caused by insects or other non-insect related factors. Data for each field were collected every two hours from ears entering the cannery while the ears were processed.

Relationships between specific causes and defective kernels. A major goal of the project was to identify the key insects or non-insect factors that caused the majority of the defective kernels. Based on assessments of husked ears prior to entering the cannery, sap beetle injury, stink bug injury and blemishes accounted for 34.8, 25.9 and 39.3% of the total number of defective kernels. These relative contributions were in agreement with the 2-hour assessments tracked through the processing of each field. The total number of defective kernels recorded from ears prior to entering the cannery showed significant positive correlations with estimates of defective kernels ($r = 0.44$, $p = 0.001$) and damaged ears ($r = 0.28$, $p = 0.041$) assessed in the cannery. This means that the relative levels of kernel injury were consistent regardless to where the samples are taken, even though sample sizes were different and assessments were performed by different inspectors. There were also significant positive correlations between the number of sap beetle-damaged kernels ($r = 0.43$, $p = 0.002$), stink bug-damaged kernels ($r = 0.31$, $p = 0.024$), and blemished kernels ($r = 0.37$, $p = 0.018$) and the percentage of damaged ears. Similarly, the percentage of defective kernels per field was more positively related to the number of blemished kernels ($r = 0.39$, $p = 0.013$) than the other causal factors. Interestingly, although field infestations of stink bugs were higher and detected more frequently (73.6% of the fields) than infestations of sap beetles (27.6% of the fields), field monitoring data showed no clear relationship with the number or percentage of defective kernels entering the cannery. Only field data on sap beetle infestations showed as near significant correlation with the defective kernel levels ($r = 0.21$, $p = 0.062$). The incidence and amount of kernel injury caused by corn earworm also had no relationship with the defective kernel levels. Taken altogether, results indicate that sap beetles and blemished kernels were the major causes of defective kernels in processing sweet corn in 2014.

Effectiveness of Bt Sweet Corn using different insecticide spray schedules. Bt sweet corn hybrids do not provide complete suppression of corn earworm damage, so processors may have to apply one or two insecticide applications to ensure processing quality ears, especially under high pest pressure. For Bt hybrids, protein expression in silk tissue kills nearly all earworms but those hatching later in the crop cycle can invade the ear, without feeding on silk tissue, and are then exposed to lower levels of protein expression in the kernels. This delayed ear invasion by earworms suggests that more effective control may be possible by applying insecticides later in the crop cycle of the Bt hybrids. Thus, this study provided information on the number and timing of insecticide applications required to achieve quality processing ears, which is essential for developing insect management recommendations for the Bt sweet corn technology. In a replicated field plot study conducted at the Central Maryland Research and Education Center, Beltsville, MD, we measured the level of insect pest protection and ear quality under the following ten different hybrid/treatment schedules: 1) untreated non-Bt isolate; 2) non-Bt isolate treated with conventional insecticides based on insect trap data and in-field inspections of the pest complex; 3) untreated Bt hybrid; 4) Bt hybrid treated 1X at early silking; 5) Bt hybrid treated 2X at early silking and 4 days later; 6) Bt hybrid treated 1X at 4 days after early silking; 7) Bt hybrid treated 2X at 4 and 8 days after early silking; 8) Bt hybrid treated 1X at 6 days after early silking; 9) Bt hybrid treated 2X at 6 and 11 days after early silking; and 10) Bt hybrid treated 2X at 8 and 14 days after early silking. The insecticides (rate/acre) used were Beseige (10 oz), Lannate (1.5 pts), and Warrior II (1.9 oz). Beseige was used in treatments applied during early silk and timings at 4 and 6 days after silking, whereas Lannate and Warrior were applied as a tank mix for later applications. Treatments were applied with a self-propelled high clearance sprayer delivering 100 gallons/acre at 60 psi.

Blacklight and pheromone trap were operated over the crop cycle to assess the population pressure of CEW, ECB and FAW. Weekly scouting of plots before and after silking was also conducted to identify any agronomic problems and unusual insect infestations, especially sap beetle activity. If whorl stage plants became infested with FAW, the level of injury was assessed by examining plants on two center rows per plot. At peak fresh market maturity, all marketable ears in the center two rows of each plot were examined external evidence of husk injury or worm entry, and number of unmarketable ears with evidence of external husk injury or worm entry. For each plot, a random sample of 40 primary ears were hand pulled from center four rows and carefully husked to record the amount and location of kernel injury by pest species. The amount of kernel damage was estimated visually as the cm² of kernel surface area consumed for each pest. The number of live and dead larvae found in the ear was recorded by instar for each species (CEW, FAW, ECB). If the damaged kernel area exceeded 8 cm² with heavy deposits of frass, discarded head capsules, and an exit hole present, then an assumed exited larva was recorded as a prepupal instar. For sap beetle injury, data were recorded on the number of kernels damaged and the location of damage. Data were summarized as the percentage of marketable ears, percentage of ears damaged by each insect, and location and extent of kernel consumption. Percentage of marketable ears was computed on the basis of CEW and ECB damage-free ears only. All data endpoints were analyzed using SAS software programs to compute means and standard errors, and several statistical indices and residual plots to check the assumptions of ANOVA. The mixed model procedure was used to test for treatment effects, after data transformations were made for lack of normality and unequal variances. Data were analyzed separately for each endpoint, with hybrid and insecticide treatment as fixed factors and replicate block as a random factor. Tukey's option was used to test for significance ($P < 0.05$) among multiple mean comparisons.

Although pest pressure by corn earworm was moderate, results showed a significant advantage of using the Bt sweet corn technology over the non-Bt hybrid treated with conventional insecticides. A combined total of seven treatments (one for FAW during the whorl stage and six applied later during silking and ear development for CEW) were applied on the non-Bt plots to achieve 94.4% marketable ears, whereas only one application applied 4 days after early silk to the Bt plots resulted in 98.8% marketable ears. Of the different spray schedules, a single application of Besiege applied when 100% of the Bt ears had silked (about 5-6 days after the first onset of silking) was sufficient to ensure fresh market quality. This timing compared to an earlier silk application conserves minute part bugs which provide an important ecological service by feeding on eggs and small larvae during the fresh silking period. An application 5-6 days after the first onset of silking is also the best timing for maximum protection against sap beetles, since these insects are attracted to the ear zone at this time to lay eggs as the silk tissue degrades.

Based on pest pressure experienced in 2014 and the number of applications required to produce processing quality ears in non-Bt sweet corn, the Bt technology reduced the amount of insecticide control by at least six applications. With additional pressure by FAW (which often requires multiple sprays during the whorl growth stages), increased CEW resistance development to pyrethroid insecticides, and the subsequent need for more expensive insecticides with different modes of action, the value of the Bt technology will likely increase.

Table 1. Effectiveness of Bt sweet corn and its non-expressing isoline under different insecticide treatment schedules for control of corn earworm. Beltsville Research and Education Center. 2014.

Hybrid/treatment schedules	Percentage of ears in each category			
	Marketable	Damaged by corn earworm	Tip injury	Side injury
Non-Bt (no sprays)	5.0 c	96.3 a	94.4 a	63.8 a
Non-Bt (6 sprays, 4 days apart starting at ES)	94.4 ab	5.6 bc	5.6 bc	0.0 b
Bt (no sprays)	86.9 b	15.6 b	13.1 b	2.5 b
Bt (1 spray at ES)	96.3 ab	8.3 bc	6.9 bc	0.6 b
Bt (2 sprays at ES and 4 days after)	98.8 a	2.5 c	1.9 c	0.0 b
Bt (1 spray at 4 days after ES)	98.8 a	3.8 bc	3.8 bc	0.0 b
Bt (2 sprays at 4 and 8 days after ES)	98.8 a	1.9 c	1.9 c	0.6 b
Bt (1 spray at 6 after ES)	91.3 b	9.4 b	9.4 b	1.3 b
Bt (2 sprays at 6 and 11 days after ES)	93.1 b	7.5 bc	6.9 bc	0.6 b
Bt (2 sprays at 8 and 14 days after ES)	96.9 ab	3.8 c	3.1 c	0.0 b

ES (early silk) - percentage of plants with fresh silking across all plots averaged 13.6% on August 14; but the earliest sprays were applied on August 15, so the timing was likely around 50% silking.

Means within a column followed by the same letter are not significantly different ($P = 0.05$).

Significance of treatment effects: marketable - $F_{(9,30)} = 40.2$, $P < 0.001$; earworm damage - $F_{(9,27)} = 37.9$, $P < 0.001$; tip injury - $F_{(9,27)} = 37.5$, $P < 0.001$; side injury - $F_{(9,30)} = 24.9$, $P < 0.001$.

Goals and outcomes achieved. The project was initiated to address the potential damage of the invasive BMSB on sweet corn, which the processing industry suspected to be the primary

cause of defective kernels, resulting in reduced grade quality of the final product. Although this invasive pest was the major focus, results showed that stink bug populations were not present in most fields and infested areas consistently occurred only on outer field edges, representing a very minor portion of the acreage. Second year work conducted confirmed that BMSB was not a major cause of the defective beans, and in fact the native brown stink bug was more consistently found. Project activities shifted to more intensive field and cannery sampling to identify causal factors, with the aim to develop a better monitoring program and cost-effective management strategy, both in the field and at the cannery.

Although overall insect pest populations in sweet corn were very low, one measurable outcome was the information provided on the within-field spatial and temporal patterns of sap beetle and brown stink bug infestations, which had practical implications for improvements in field monitoring, spray applications, and decisions in the cannery to minimize grading problems. Ear and kernel damage assessments determined that sap beetles and blemished kernels were the major causes of defective kernels, even though native stink bugs were more abundant and detected more often.

Another measurable outcome was information provided by the different spray schedules tested. The standard control practice by the processing company was to initiate insecticide applications prior to the onset of silking. Spray timing results determined that this schedule was too early for sap beetles, and that a single insecticide application applied when 100% of the Bt ears have silked (about 5-6 days after the first onset of silking) was sufficient to ensure processing quality, given the low population pressure. This timing compared to an earlier application also conserves important insect predators, such as minute part bugs, that feed on eggs and small larvae during the fresh silking period. Results also showed that an application 5-6 days after the first onset of silking was the best timing for maximum protection against sap beetles, since these insects are attracted to the ear zone to lay eggs as the silk tissue degrades. This information is now used by the processing industry to modify insecticide control programs, so that the most effective insecticide product and timing of applications are implemented. As a result of low moth activity and consistent high quality ears from earlier harvested fields, insecticide treatments were timed better and the number of applications per field was reduced by 20% compared to previous practices.

To monitor the quality of ears entering the cannery, the project provided one-to-one training to enable cannery personnel to assess ear damage and identify the key insect pests or non-insect factors causing kernel injury. Visual identification aids (*Additional Information*) were developed for the quality control technicians as a reference to show the different kernel feeding insects and their injury and characteristic appearances of different types of defective kernels. Some of visual descriptions have been incorporated into presentations given at University of Maryland Extension twilight meetings and also used as guides for separating sap beetle and stink bug in other studies. Another outcome is a quantitative rating system that was developed and implemented to track levels of defective kernels as a means to predict the potential impact on the grade of the processed product. A protocol for sampling ears entering the canopy was developed to measure defective kernels and this information was used to modify parameters of the optical sorting equipment for more liberal removal of defective kernels and to make decisions about the type of processed product depending on expected risk of grading problems. Our intent was to incorporate the knowledge gained by this project into an existing sweet corn management guide with updated recommendations on how to sample and manage stink bugs. Although the invasive BMSB as well as native species contributed very little to the defective kernel problems, we will

be incorporating certain sampling protocols and stinkbug identification aids into the Extension guide. Furthermore, details of the kernel damage and population dynamics of stink bugs on sweet corn will be presented in a scientific article, accepted and due to be published soon in the Journal of Economic Entomology.

Beneficiaries. The project involved one processing company which now has a better understanding of the pest and non-pest factors affecting ear quality and has taken steps to change monitoring and field/cannery management practices to reduce defective kernel levels. This company contracted the majority of processing sweet corn acreage on the Delmarva Peninsula, involving about 50 growers who are responsible for producing around 7,000 acres of the crop, on which they were responsible for managing any pest related problem that affects yield. The field monitoring was able to detect and identify several yield reducing problems, namely armyworm infestations, which helped several growers apply timely insecticide applications. Otherwise there was only minimal involvement by individual growers, owing to the pest management decision-making nature of the project and the overall low insect pest populations. However, the insecticide timing information and knowledge of the pests reducing ear quality have been delivered by two extension presentations (one at the Mid-Atlantic Fruit and Vegetable Conference in Hershey PA with about 150 attendees) and two twilight meetings to other growers for managing pest problems on fresh market sweet corn.

Lessons Learned. We clearly showed that stink bugs were not the major cause of defective kernels that reduced the final grade in the processed product. In fact, non-insect factors accounted for a significant amount of the quality control issues. Yet, it was difficult to convince the cannery management to reduce the number of insecticide sprays applied per field, without further demonstration studies to compare different control programs. Based on the lessons learned in the study, if corn earworm populations continue to show a downward trend in moth activity, as evident during the past five years, we believe that the lessons learned from field and cannery monitoring could lead to much reduced spray program, while still achieving the same level of ear quality. With respect to the defective kernel levels entering the cannery, there still remains a major challenge to accurately distinguish kernel injury caused by sap beetles, stink bugs and non-insect blemishes. Additional training is needed to increase the skill level of the quality control technicians to identify specific causes of defective kernels.

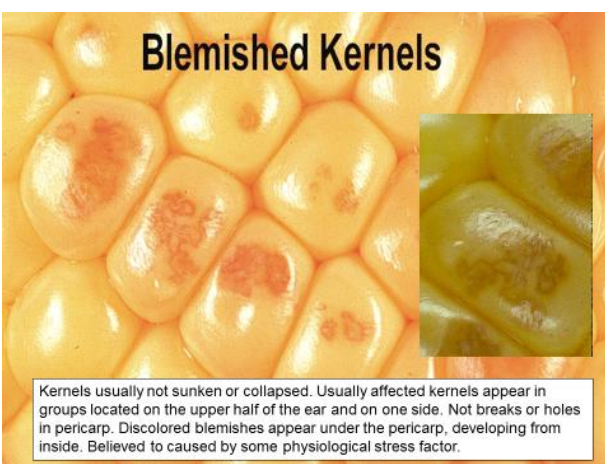
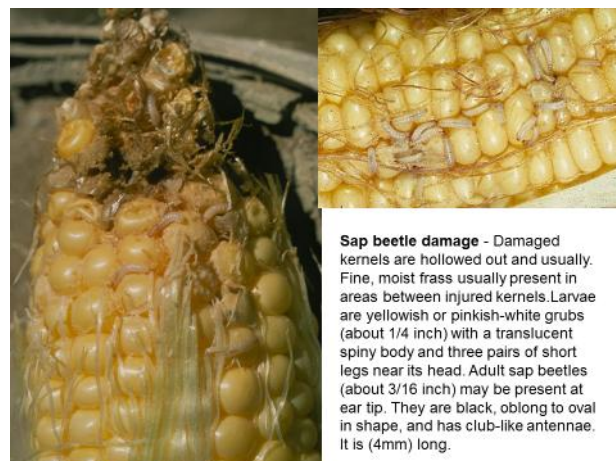
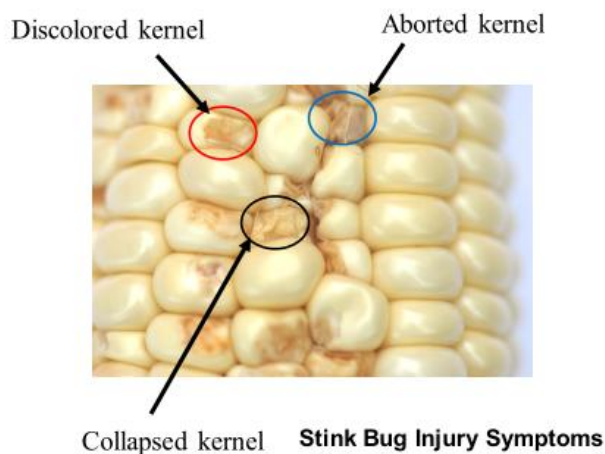
Contact Person

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Additional Information: Visual Aids for Identifying Ear-Invading Insects and Causes of Kernel injury in Sweet Corn



FINAL REPORT

Project Title: Maryland Guide to Sustainable Viticulture for Winegrape Growers

Project Summary

Possibly the most important resource of the state of Maryland is the Chesapeake Bay. The Bay adds millions of dollars to the state's economy and often defines the way of life and culture of its citizens. The protection of this valuable resource is a top priority of Maryland's government and people. Agriculture, including the growing of wine grapes, has a large impact on its quality. Because of the rapid growth of population around the Bay's shore, it is imperative that changes be made now to stop its degradation.

The development of this sustainability workbook provides grape growers with a systematic way of evaluating the cultural practices used in their vineyards. These evaluations then aid in developing programs and making decisions that make their operations, and thus the Bay more sustainable.

Interest in sustainable agriculture has been growing throughout the nation and around the world. This includes interest in sustainable grape growing. While there is some information on sustainable grape growing available in literature and on the internet, this information is generally not of much use to growers in Maryland. Wine grape growing, by necessity, varies vastly in different areas of the world and nation. Even in a state as small as Maryland there are distinct growing regions which greatly affect the ways in which grapes are grown. This work book is specifically designed to meet the unique needs of grape growers in Maryland

Project Approach

Purchased rights to adapt New York Guide to Sustainable Viticulture Practices from Cornell University. While it provided a good template and organizational guidelines, its content was not extremely useful as growing conditions, weather, soils, elevations, grape varieties, etc. are quite different.

Several respected wine grape grower members of the Maryland Grape Growers Association and the University of Maryland Extension Service, particularly Dr. Joseph Fiola, Extension Specialist, Viticulture & Small Fruit, were recruited to study the New York book and develop a workbook book tailored for Maryland. The result is A Sustainable Practices Workbook for Wine Grape Growing in Maryland, a one hundred twenty page, illustrated guide to sustainable wine grape growing workbook.

The draft of the workbook, after being approved by the Grant Steering Committee, was sent out to a professional typist and layout person. One hundred fifty of the workbooks were professionally printed.

Three regional training sessions were held to introduce growers to the workbook. Besides grape growers, University of Maryland Extension educators were invited to attend. Sixty people attended these sessions. Each attendee was presented with a workbook. Each session was

planned to last three hours, but all ran long due to interest of the attendees. Classes were taught by Dr. Fiola with assistance by Bob White, President Maryland Grape Growers Association and Bruce Perrygo, Coordinator Maryland Grape Growers Association. An abbreviated session was presented at the Maryland Grape Growers Association's Summer Field Day and Seminars.

Five months after the classes, a survey was emailed to everyone who attended the workshops. All who replied were very happy with the workshop and the workbook. They all said that they had developed sustainability plans and were beginning to implement them. They all answered the question, "Have/would you recommend A Sustainable Practices Workbook for Wine Grape Growing in Maryland to other grape growers?" in the affirmative.

There will be a session on the workbook at the Annual Maryland Grape Growers Association's Annual Conference and Seminars to be held in February 2017. This conference is attended by approximately one hundred twenty five individuals.

A Sustainable Practices Workbook for Wine Grape Growing in Maryland has been posted on the Maryland Grape Growers Association's website www.marylandgrapes.org where it is available to download at no cost to the general public as well as Association members. Permission has been granted to the Maryland Wineries Association to link to the workbook. Members of The Governor's Advisory Commission on Maryland Wine and Grape Growing also received copies of the workbook.

Goals and Outcomes Achieved

A workbook, A Sustainable Practices Workbook for Wine Grape Growing in Maryland was developed to meet the unique needs of wine grape growers in Maryland.

This is a one hundred twenty page, illustrated workbook with self evaluation guides and checklists. Three training sessions were held at locations around the state.

The evening of the first workshop, we received an email from a winery owner who said due to the class, that night he met with his vineyard manager and began making plans to change their operating procedures to a more sustainable approach.

Sixty people attended these sessions including educators from the University of Maryland Agriculture Extension Service.

An abbreviated class was held in conjunction with the Maryland Grape Growers Association's Summer Field Day and Seminars.

Attendees of these classes received bound copies of A Sustainable Practices Workbook for Wine Grape Growing in Maryland.

Each University of Maryland Extension Service office has received a copy of the workbook.

Copies of the workbook were presented to two wineries, Frogs Leap and Honig, both considered to be leaders of sustainable grape growing in California.

The Maryland Wineries Association has been granted to permission to post the workbook on their website, or to provide a link to it.

The Maryland Grape Growers Association has received several requests to hold more workshops on the workbook

A workbook session has been scheduled for the Maryland Grape Growers Association's Annual Conference and Seminars to be held in February 2017. This is a joint conference with the Maryland Wineries Association.

All of the primary goals of the grant program have been met.

The enthusiasm for the program has greatly exceeded expectations.

Time allotted for the workshops did not allow pre and post tests.

We had 57 members attend the Sustainability Workbook classes. Farmers are notorious in their poor response to surveys. Unfortunately, we had the same result, with fewer than 25% responding.

However, almost never seen in surveys, all responded yes to each question. We can safely assume that a large majority of attendees would have responded similarly. There were some comments. Some claimed major changes in their production practices while others reported they were happy to find they needed only "minor tweaks."

Question #6 Have/would you recommend A Sustainable Practices Workbook for Wine Grape Growing in Maryland to other grape growers? Received an enthusiastic yes from all responders.

As we have never kept a record of visits to the Maryland Grape Growers Association's website, we could not find a practical way to measure increased activity. We posted the information on MGGA's Facebook page with over 540 followers; several articles were written in our newsletters that is sent to over 230 people.

Beneficiaries

Two hundred twenty seven members of the Maryland Grape Growers Association, then continues with the following:

University of Maryland Extension Service educators

Commercial and non-commercial grape growers in Maryland

Commercial and non-commercial grape growers in the Mid-Atlantic
Wineries in the Mid-Atlantic

The Governor's Advisory Commission on Maryland Wine and Grape Growing

Any farmer or even hobbyist gardener in the Mid-Atlantic.

Tourists, as wineries and vineyards are a major tourist draw and frequently receive education on grape growing and agriculture at the wineries

All who are affected by the Chesapeake Bay.

The economic effect starts at the vineyard level. To be sustainable, a vineyard must be economically viable. This is emphasized in the workbook. This helps produce economic health for wineries. Any agricultural venture that makes use of the work book should benefit from its suggestions. The Chesapeake Bay is one of the economic engines of both the states of Maryland and Virginia. It is hard to calculate the economic assets of a living, clean Chesapeake Bay.

Lessons Learned

A project was difficult to complete by an organization that is chiefly run by volunteers. Change in the group's leadership due to health and family issues delayed the completion of the project.

The use of volunteers means the timeline should be much longer than anticipated.

The hiring of an experienced typist/layout person was extremely valuable.

Having background information before the project started, e.g. pictures, charts, surveys, experts, pictures, etc. was useful.

Time allotted for the workshops, a three hour afternoon, even though the workshops were extremely successful, should have been longer. We did not have time for pre and post assessment, though, we sent out a follow-up survey via email to the workshop attendees and we had a 50% response rate.

A computer expert should have been hired early in the process to aide in developing better means to quantify the results.

Contact Person

Bruce Perrygo

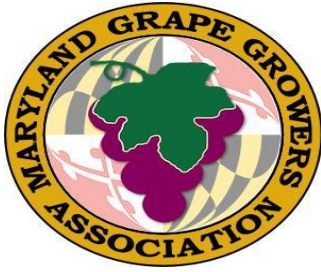
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Additional Information

A Sustainable Practices Workbook for Wine Grape Growing in Maryland is available on-line at www.marylandgrapes.org

Workshop Agenda



Program for Sustainable Viticulture Workshops

Resource:

A Sustainable Practices Workbook for Wine Grape Growing in Maryland

Registration

Introductions and overview of seminar goals

Bruce Perrygo, Coordinator, Maryland Grape Growers Association

Bob White, President, Maryland Grape Growers Association

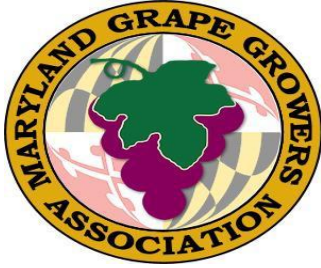
Joseph A. Fiola, Ph.D., Specialist in Viticulture and Small Fruit University of Maryland Extension, Keedysville, MD

Workshop Topics – Presentation with open discussion and Questions

- I. Soil Management
- II. Nutrition Management
- III. Vineyard Management
- IV. Irrigation Management
- V. Weed Management
- VI. Pest Management
- VII. Pesticide Management
- VIII. Continuing Education
- IX. Action Plans

Q&A

Adjourn



Program for Sustainable Viticulture Workshop Survey

1. Do you find *A Sustainable Practices Workbook for Wine Grape Growing in Maryland* a useful tool?
- 2 Did the Sustainability Workbook class help you make use of the Workbook?
- 3 Have you developed an action plan of some type?
- 4 Have you prioritized production modifications?
- 5 Have you made changes in your operating procedures or plan to do so at the appropriate time?
- 6 Have/would you recommend *A Sustainable Practices Workbook for Wine Grape Growing in Maryland* to other grape growers